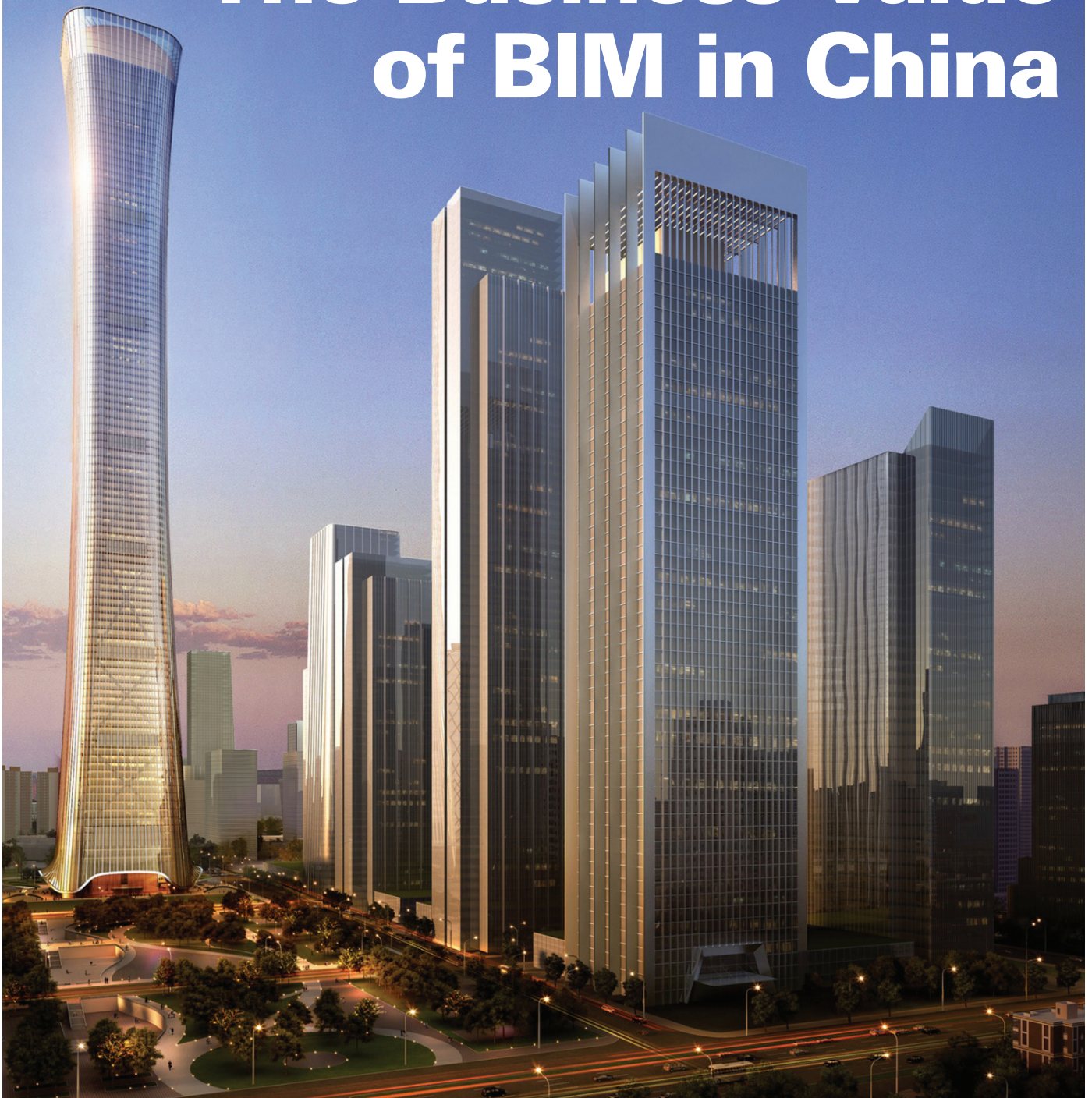


# The Business Value of BIM in China



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# SmartMarket Report

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## The Business Value of BIM in China SmartMarket Report

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## About Dodge Data & Analytics

Dodge Data & Analytics is the leading provider of data, analytics, news and intelligence serving the North American commercial construction industry. The company's information enables building product manufacturers, general contractors and subcontractors, architects and engineers to size markets, prioritize prospects, target and build relationships, strengthen market positions, and optimize sales strategies. The company's brands include Dodge, Dodge MarketShare™, Dodge BuildShare®, Dodge SpecShare®, Dodge DocuPro, Sweets, *Architectural Record*, and *Engineering News-Record*.

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## Introduction

China is generating an impressive variety of world-class projects throughout the country and increasingly applying innovative processes using Building Information Modeling (BIM) that both enhance design and improve construction productivity.

Since 2007, Dodge Data & Analytics has been tracking the business impacts of technology advances through its *SmartMarket Report* series, with a particular focus on how BIM is transforming the design and construction process in Asia, Australia, North America and Western Europe.

This new report analyzes survey data collected from Chinese-based architects and contractors who are currently using BIM on projects, and also from those who have not yet become involved with BIM. Among BIM users, the report examines their level of involvement, benefits, investments, perceived value and future plans for BIM. Among non-users, it explores their reasons for non-adoption and triggers that will initiate adoption. Among the key findings:

- **Implementation Growth:** The percentage of organizations that are at a high BIM implementation level (meaning at least 30% of their projects involve BIM) is projected to double in the next two years (89% growth for architects and 108% growth for contractors). This is a sure signal of China's significant commitment to BIM.
- **BIM Benefits:** Chinese architects and contractors enjoy the same powerful business benefits from BIM as their peers

around the world. And they are global leaders when it comes to using BIM to generate faster client approval cycles, with 64% reporting receiving this benefit at a high/very high level, causing it to be ranked second, while among global contractors, this benefit ranked a distant sixth. Faster client approval cycles can have a dramatic impact on reducing overall project delivery schedules and more effectively engaging owners in project design and construction.

- **Non-user Attitude:** Results of this research are extremely encouraging for continued growth of BIM in China, where the vast majority of non-users (89%) express a positive attitude about BIM, and none (0%) say that they have used it and decided not to use it again. China can expect significant continued expansion of BIM adoption and implementation.

This is truly an exciting era for the design and construction economy in China. As exceptional projects proliferate throughout all regions, owners, architects and contractors can leverage new model-based technologies and processes to improve design, productivity, efficiency, quality, safety and their own competitiveness.

Dodge Data & Analytics wishes to thank our partners for their support that allows us to continue to bring this exciting information to the industry and looks forward to continuing to track the progress of BIM in China.



**Stephen A. Jones**  
Senior Director  
Dodge Data & Analytics



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**Stephen A. Jones** leads DD&A's initiatives in BIM and how emerging economic and technology trends are transforming the construction industry. Active in numerous industry associations (including the buildingSMART Alliance, the BIMForum, Construction Users Roundtable, Alliance for Construction Excellence and Charles Pankow Foundation), Jones frequently speaks at events around the world on the business impact of emerging technology and trends. He also hosts DD&A's ENR FutureTech and

High Performance Construction events. Before joining DD&A, Jones was a vice president with Primavera Systems (now part of Oracle), a global leader in project management software. Prior to that, he spent 19 years in creative and management roles with top design firms, most recently as a principal and Board of Directors member with Burt Hill (now merged with Stantec), one of the largest A/E firms in the U.S. Jones holds an M.B.A. from Wharton and a B.A. from the Johns Hopkins University.

**Harvey M. Bernstein, F.ASCE, LEED AP**, has been a leader in the engineering and construction industry for over 30 years. Currently, he has lead responsibilities for DD&A's market research group, including DD&A's thought leadership initiatives in areas such as commercial and residential green building, BIM, information mobility, innovation and global construction markets. Prior to joining DD&A, Bernstein served as President and CEO of the Civil Engineering Research Foundation. He has written hundreds of papers covering

innovation and sustainability, and currently serves as a member of the Princeton University Civil and Environmental Engineering Advisory Council and an elected member of the National Academy of Construction. He is a visiting professor with the University of Reading's School of Construction Management and Engineering in England. Bernstein has an M.B.A. from Loyola College, an M.S. in engineering from Princeton University and a B.S. in civil engineering from the New Jersey Institute of Technology.

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**Front Cover:**

The Beijing Institute of Architectural Design (BIAD) and conceptual design firm KPF used BIM in the design of the iconic Z15 Tower in Beijing.

**This page:**

Shanghai Tower, shown here under construction, has a twisting, double glass facade that took advantage of modeling in its design.

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# Executive Summary

**China is very much aligned with other progressive global construction markets in its enthusiasm for BIM and appreciation of its value—both for the projects it is used on and to the organizations using it.**

The findings in this report demonstrate that China is progressing in its use of advanced technologies to help give its design and construction industry a competitive edge in the global economy.

## BIM Implementation in China

Chinese architects and contractors who are currently using BIM say that they are planning to greatly increase their level of BIM implementation—the percentage of projects that involve BIM—over the next two years.

- With a forecast of 108% growth, China is among the top five fastest-growing BIM regions surveyed by Dodge Data & Analytics (formerly McGraw Hill Construction) for contractors who will be doing more than 30% of their work in BIM two years from now.
- The percentage of Chinese architects doing more than 30% of their work in BIM is forecasted to nearly double over the next two years.

## ROI on BIM is Directly Related to Implementation

Consistent with other Dodge Data & Analytics' BIM research around the world, a Chinese organization's return on its investment (ROI) in BIM increases dramatically with its depth of commitment to BIM.

- Positive ROI is reported by over two thirds (68%) of BIM users who do more than 30% of their projects with BIM, and only a handful (7%) are still at a negative ROI.
- Conversely, less than half as many (30%) of the users at a low implementation level (i.e., less than 15% of their projects involve BIM) report positive ROI. In fact, the same proportion (29%) report they are still at a negative ROI.

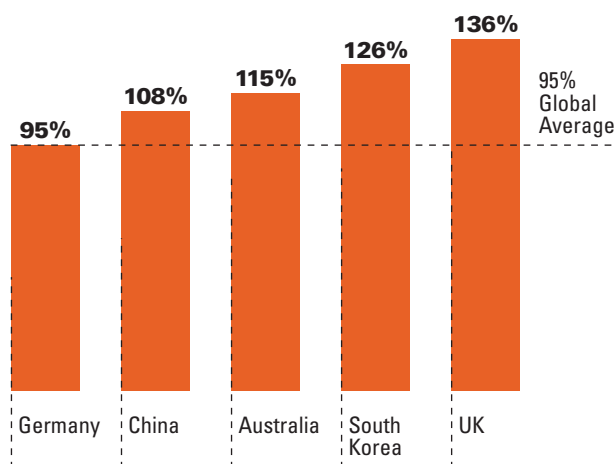
## BIM Investments

BIM software, customizations and interoperability solutions are leading technology-oriented BIM investment categories for both architects and contractors, a reflection of the fast growth of BIM in the entire Chinese industry. Also, architects rate new/upgraded computer hardware at the top of their list of planned technology investments, owing to their need to author and analyze increasingly complex models.

## Top Five Fastest-Growing Regions for BIM Implementation by Contractors

(Two-Year Forecast for Increase in Number of Contractors Doing Over 30% of Their Projects With BIM)

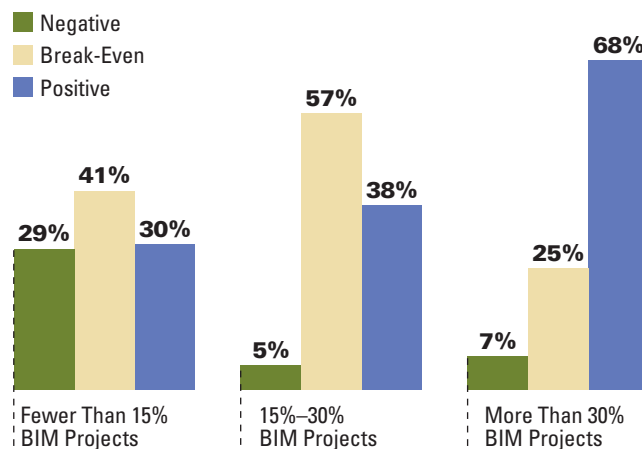
Dodge Data & Analytics, 2015



## Perceived Return on Investment (ROI) for BIM Users in China

(By Level of BIM Implementation)

Dodge Data & Analytics, 2015



Interestingly, in the areas of people and process investments related to BIM, almost twice as many Chinese contractors plan to invest in promotion incentives for staff use of BIM than do Chinese architects.

### BIM Benefits

Chinese architects and contractors mostly agree on the degree to which their projects are benefiting from BIM.

- **Better design solutions and reduced errors and omissions in construction documents are in the top two for each.**
- **They are also aligned on the experience of greater client engagement resulting from BIM.**
- **Construction phase benefits of fewer field problems and reduced rework are also highly rated by both architects and contractors, indicating an appreciation for the downstream value of a BIM design.**

### BIM and Trade Contractors

Trade contractors with good BIM skills are critical in order to continue to strengthen China's technological capability in model-based construction, which is a fast-growing BIM trend throughout the world.

**Over half of Chinese general contractors believe strongly that trade contractors having BIM skills will reduce project cost and duration, and increase innovation, project quality and contractor profit.**

Over half perceive steel and mechanical trades to have satisfactory BIM skills, but many note that curtain wall, electrical, concrete and civil firms need to improve their BIM skills.

### Non-Users

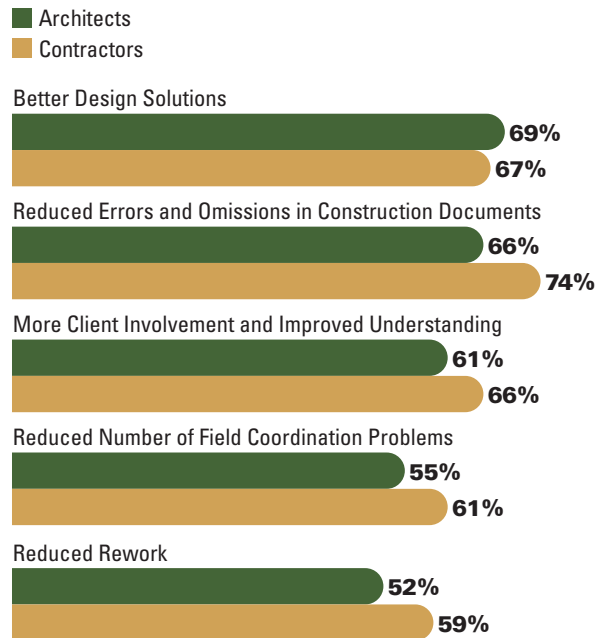
While the research for this report focused primarily on architects and contractors in China who are currently using BIM, understanding the perspective of non-users is important to accelerate the pace of future adoption.

**Organizations not using BIM in China are generally very open to its use and positive about its potential.**

- **Most non-users (89%) are interested in BIM.**
- **In fact, a large percentage (39%) are actively underway evaluating BIM, and only a few (11%) express no interest in using it.**

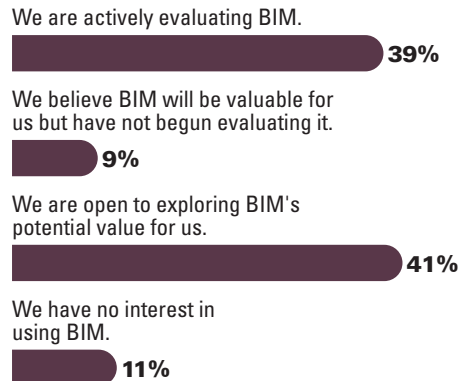
### Top Five Project Benefits Generated by BIM (By Percentage of Chinese Companies Receiving Benefit at High or Very High Level)

Dodge Data & Analytics, 2015



### Non-User Attitudes Toward BIM (According to Chinese Architects and Contractors Who Do Not Use BIM)

Dodge Data & Analytics, 2015





# Recommendations

## Observations and Recommendations

**China is well on its way to integrating BIM-based technologies and practices into its robust construction economy. Based on the findings of this research, there are several areas of recommended focus to accelerate this positive momentum.**

### **Large Chinese Organizations Should Encourage Smaller Ones to Adopt and Expand BIM to Improve the Entire Industry**

The large architectural and construction organizations in China generally have more BIM experience than their smaller peers, and more of them plan to use BIM on a higher percentage of their projects two years from now (see page 9). Research from all areas of the world shows that the benefits of BIM are increased when more team members are skilled and engaged with it, which means the smaller organizations need to get involved.

Therefore, it is important that the leading users make efforts to encourage non-users to adopt, and those at lower levels of implementation become more deeply engaged. This will accelerate the already impressive pace of BIM advancement in China.

### **Develop 3D Content Libraries That Support the Project Lifecycle**

The most powerful future use of BIM will be to support the entire project lifecycle. Therefore, 3D BIM content needs to be created that will be useful to stakeholders from design through to facilities management and replacement.

Content creation is a common investment need identified in many of Dodge Data & Analytics' BIM research studies around the world. For example, it ranked third among all users in both *The Business Value of BIM in Korea SmartMarket Report* (2012) and *The Business Value of BIM in Australia and New Zealand SmartMarket Report* (2014).

Chinese architects and contractors need to work with product manufacturers to urge them to create useful libraries of BIM content that can be easily accessed and used so that companies can reduce their need to develop content internally.

### **Embrace the Advantages of Model-Driven Prefabrication**

The use of coordinated models to drive offsite and near-site prefabrication of assemblies that integrate the work of several trades is one of the most highly valued BIM activities in many advanced BIM markets. Prefabrication improves project schedule because assemblies can be manufactured well in advance, then brought to a site ready-to-install at just the right moment. When built in a shop setting, the quality can be more carefully controlled, weather is not a factor, and the working conditions are usually safer. This approach also reduces onsite material deliveries, storage, management and waste, as well as lowering cost by using relatively inexpensive shop labor instead of more expensive field labor.

The findings in this research among Chinese contractors show a relatively low assignment of value to increased prefabrication as a factor that would improve their ROI of BIM (tied for

next-to-last place out of nine factors).

The Chinese market seems particularly well suited for greater use of prefabrication. Chinese projects are increasingly sophisticated and complex, which enhances the potential value of prefabrication. Also, labor and material prices can be expected to rise over time, again providing a benefit to prefabrication. As they mature in their use of prefabrication, contractors may also be able to take advantage of the wealth of manufacturing expertise available in China.

All of this demonstrates that contractors in China need to recognize the benefits that prefabrication offers to project cost, schedule and quality, and more actively pursue the advantages of model-driven prefabrication on their projects. Embracing this trend is an excellent opportunity for them to add value to the overall BIM process. ■



# Data: Introduction

China is possibly the world's most important construction market. Recent measures of the size of the market place it at well over 13 trillion RMB (over US\$2 trillion).<sup>1</sup> While this includes a robust degree of investment in horizontal infrastructure, such as dams and transportation projects, it also includes a strong investment in vertical building construction. In fact, China has added 1.8 to 2 million square meters of floorspace annually for more than a decade.<sup>2</sup> Clearly, when it comes to technologies and processes that improve efficiency and profitability in the construction industry, China represents a unique opportunity.

For almost a decade, Dodge Data & Analytics (DD&A, formerly called McGraw Hill Construction) has been conducting research on the value and impact of building information modeling (BIM), not just in terms of the software itself, but also in terms of its potential to improve construction processes through its ability to enable better communication and collaboration among industry players. While the research initially focused on North America, in the last few years, the study has expanded to include an examination of the value that BIM brings in Europe, South America and Asia, providing a global context across highly diverse and unique construction markets.

This new study, looking at the responses of architects and contractors in China, builds on the broad context of DD&A's previous research to capture the unique perspective of the China market on the current value and potential of BIM. While some BIM non-users were included in the study to understand the potential for wider use across the industry, the research focused primarily on the experiences of firms already using BIM. The study looks at the benefits firms derive from its use and the types and levels of investments they are making in BIM, including their perception of the degree of return they are receiving on those investments.

In addition to the quantitative research conducted among architects and contractors, the study also features in-depth interviews with five owners of construction projects in order to capture the unique owner perspective on the use of BIM in China. Three case studies also provide specific examples of the benefits gained from the use of BIM on projects in China.

The findings demonstrate that, while BIM is relatively new in China, its utilization is growing rapidly, especially among larger firms that can capitalize best on its value currently. It demonstrates that the Chinese market is beginning to experience the benefits of BIM and suggests the potential for China's leadership in BIM use in the future.

## Note About the Data

**The data and analysis in this report are based on an online survey conducted with 350 architects and contractors in China. Nearly all respondents worked for firms doing their work exclusively in China.**

**Respondents were asked about their level of BIM use. Those using BIM to create models or to work with models created by others were identified as BIM users, and those not using BIM at all were identified as non-users. Each group was asked different questions and thus analyzed separately.**

### ■ BIM Users

- Architects: 173
- Contractors: 123

### ■ BIM Non-Users

- Architects: 33
- Contractors: 21

**The primary focus of the research was to understand BIM utilization in China, so BIM users were actively sought. Thus, this sample does not reflect the level of current adoption of BIM in China. While the number of BIM non-users is relatively small, especially among contractors, the sample is sufficiently robust to demonstrate important trending differences among non-user architects and contractors.**

**BIM users were also analyzed based on company size according to annual revenue, type of company ownership and the type of work conducted by their company. For more information on these variables, along with more information about the research conducted, please see the Methodology on page 56.**

1. National Bureau of Statistics of China. "Total Output of Construction by Region." *China Statistical Yearbook 2013*. Accessed 12 December 2014 at <http://www.stats.gov.cn/tjsj/ndsj/2013/indexeh.htm>.

2. Yu S, Evans M. and Shi Q. Pacific Northwest National Laboratory. *Analysis of the Chinese Market for Building Energy Efficiency*. March 2014. Accessed 12 December 2014 at [http://www.pnnl.gov/main/publications/external/technical\\_reports/PNNL-22761.pdf](http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-22761.pdf).

## BIM Implementation Levels

A company's level of BIM implementation refers to the percentage of its projects that involve BIM. **In China, contractors are currently at higher implementation levels than architects—and that gap is projected to increase over the next two years.**

- Nearly half (46%) of the architects are currently in the lowest level of implementation (less than 15% of projects involve BIM) compared with under a third of the contractors (31%).
- Within two years, over half (52%) of the contractors forecast they will be involved with BIM on over 30% of their work, compared with only about a third (36%) of the architects.

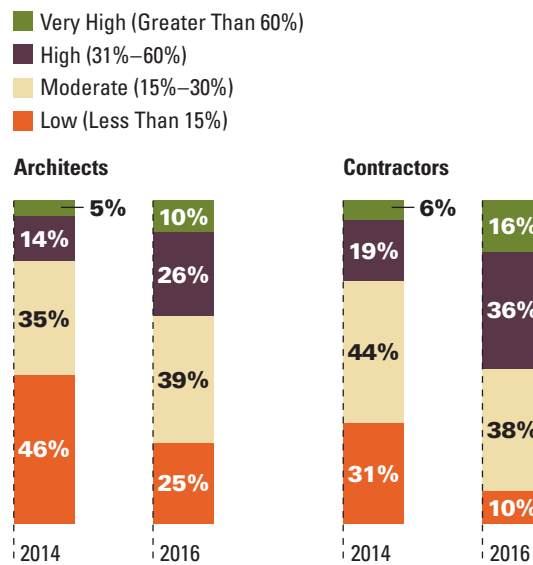
### China at the Forefront of an Emerging Trend

Although architects typically lead contractors in BIM implementation in most other global research by Dodge Data & Analytics (DD&A, formerly McGraw Hill Construction), this finding in China corresponds to an emerging trend that was first identified in *The Business Value of BIM in North America SmartMarket Report* (2012), where the contractor BIM adoption level (74%) exceeded that of architects (70%) for the first time since DD&A began its North American research studies in 2009.

### Current and Forecasted BIM Implementation Levels in China

(According to Chinese Architects and Contractors)

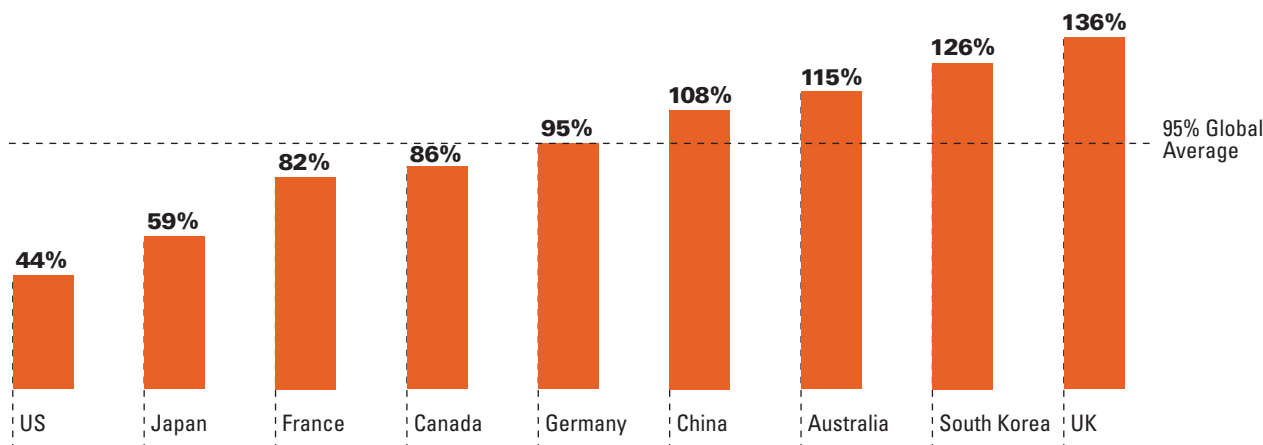
Dodge Data & Analytics, 2015



### Two-Year Forecasted Increase in Percentage of Contractors at High/Very High BIM Implementation Level

(Those With at Least 30% of Their Projects Involving BIM)

China Data: Dodge Data & Analytics, 2015; Other Country Data: *The Business Value of BIM for Construction in Major Global Markets SmartMarket Report*, Dodge Data & Analytics, 2013



## Growth of BIM Implementation Globally

BIM implementation levels are very dynamic in economies around the world as BIM experience grows and companies become more familiar, confident and innovative in their deployment of BIM.

Over the next two years, the number of Chinese contractors forecasting that they will be doing at least 30% of their work with BIM more than doubles. This aligns with contractors' predictions from a variety of other regions published in *The Business Value of BIM for Construction in Major Global Markets SmartMarket Report* (2014). The chart (see page 8) shows the two-year

forecast for growth in the number of contractors that are at high/very high BIM implementation levels (at least 30% of their projects involve BIM).

- The 136% growth in the UK can be attributed to the government mandate for BIM on centrally funded projects that will go into effect in 2016.
- South Korean and Australian contractors are actively advancing their use of BIM in response to economic activity.
- Regions where BIM is already more established (such as US, Canada, France and Germany) show slower future growth rates because many firms are already highly engaged.

## Years of Experience Using BIM

Two trends are consistent in most of the BIM research conducted by Dodge Data & Analytics around the world:

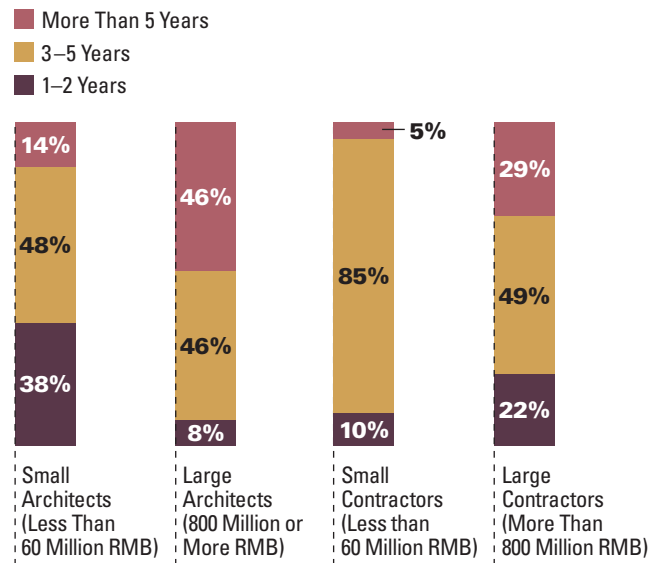
- Although architects are typically the first discipline in a region to adopt BIM, contractors now appear to be edging ahead of architects in implementation globally. Often, this is influenced by the tangible benefits contractors are able to achieve almost immediately from using BIM.
- Among both architects and contractors, BIM is typically adopted first by larger companies, and then spreads over time to smaller firms. Larger companies often work on complex projects where the value of BIM is most easily achieved and recognized. Also, those companies tend to have internal resources that can be deployed on new initiatives such as BIM and to have previous experience with technology adoption and process change, which prove valuable to successful BIM implementation.

This pattern repeats itself in findings on how long companies have been using BIM in China.

- More architects report having over five years' BIM experience than contractors.
- Size is an important factor among architects, with almost half (46%) of large firms saying that they have been using BIM more than five years, versus only 14% of small ones.
- Similarly, 29% of large contractors report more than five years' experience, compared with very few (5%) small companies.

## Number of Years' Experience Using BIM in China (By Size of Company)

Dodge Data & Analytics, 2015



- Small architects show the highest percentage of recent adoption (38%), perhaps indicating a growing interest in that segment of the industry.

## BIM Expertise Levels

Since there is no accepted international standard for BIM expertise, respondents in all Dodge Data & Analytics BIM research studies around the world are asked to self-describe their expertise level as beginner, moderate, advanced or expert, relative to their perception of other companies in their area.

**While the Chinese contractors report a higher level of BIM implementation, the chart shows that the architects are claiming a slightly higher expertise level.**

- **36% of architects are advanced or expert, compared with 33% of the contractors.**
- **More contractors (14%) perceive themselves at the beginner level than architects (10%).**

### Global Trends in BIM Expertise

Since self-described expertise levels are relative only to the region where the respondent is working, comparisons between regions are only useful for general trend analysis.

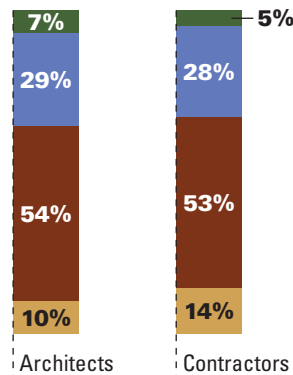
- **Just 14% of Chinese contractors rate themselves as beginners, which compares favorably to most other countries, especially the UK (37%) where the pending government BIM mandate has created a recent influx of new users.**
- **Among architects, a comparison with research from *The Business Value of BIM in Korea SmartMarket Report (2012)* shows that roughly equal proportions in China (36%) and Korea (33%) believe they are at an advanced or expert level of expertise.**

### BIM Expertise Level

(Reported by Chinese Architects and Contractors)

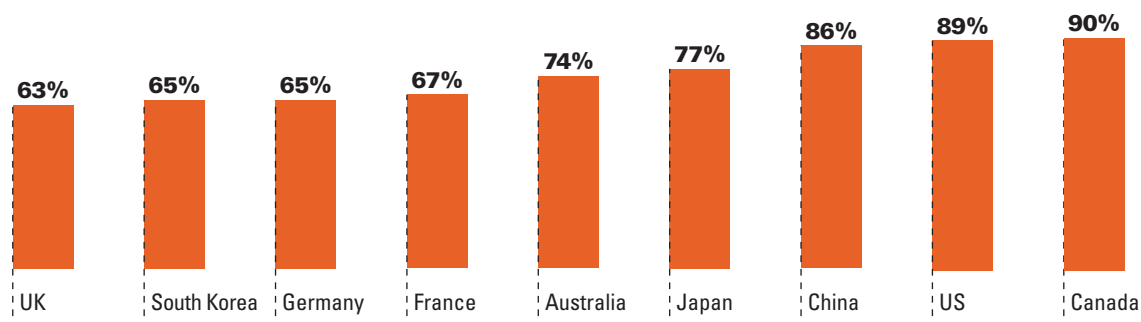
Dodge Data & Analytics, 2015

- Expert (Much Higher Than Other Firms)
- Advanced (Above Level of Other Firms)
- Moderate (About Same Level as Other Firms)
- Beginner (Lower Than Other Firms)



### Percentage of Contractors Describing Their BIM Expertise Level as Moderate, Advanced or Expert (By Country)

China Data: Dodge Data & Analytics, 2015; Other Country Data: *The Business Value of BIM for Construction in Major Global Markets SmartMarket Report*, Dodge Data & Analytics, 2013





## Familiarity and Use of Level of Development (LOD) Standard

### About Level of Development (LOD)

The need to manually re-create information in multiple technology tools by different stakeholders throughout the project process is one of the most common inefficiencies of design and construction projects. It requires duplicate work and creates the opportunity for misinterpretations, errors and omissions, often causing expensive problems later in the project lifecycle.

One of the most efficient and transformative aspects of BIM is the ability to enter project information once and then allow many users to access it with speed, certainty and reliability. Because BIM information is digital, it is machine-readable by other technology tools and therefore capable of informing workflows by numerous parties throughout the process.

The critical requirement for the industry to achieve this benefit from BIM is for all parties to understand what information can reliably be expected to be contained in a model at any given point during its lifecycle. This is where an emerging reference standard called Level of Development (LOD) plays a vital role.

According to a definition provided by BIMForum, "The Level of Development (LOD) Specification is a reference that enables practitioners in the AEC (architect, engineer, contractor) industry to specify and articulate with a high level of clarity the content and reliability of Building Information Models (BIMs) at various stages in the design and construction process." Extensive information about LOD is available from the BIMForum website ([www.bimforum.org/lof](http://www.bimforum.org/lof)) as well as many other professional organizations. (See page 13 for more information on LOD.)

### Awareness of LOD in China

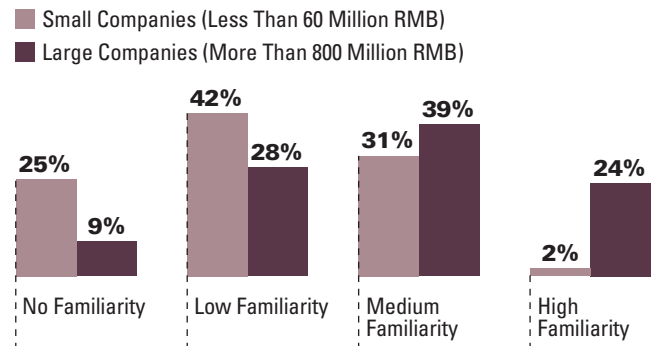
Over half of the respondents (52%) indicate a medium or high familiarity with LOD, and only a few (13%) profess no knowledge of it whatsoever. The proportions are almost equal between contractors and architects, so both types of companies are well underway with familiarization. However, as the chart shows, larger companies are significantly more aware of LOD.

### Use of LOD in China by Companies Familiar With It

Although the majority (87%) of respondents report at least some awareness of LOD, there is low evidence of its actual use on projects by these firms. The chart shows the reported use of LOD on projects by the companies that

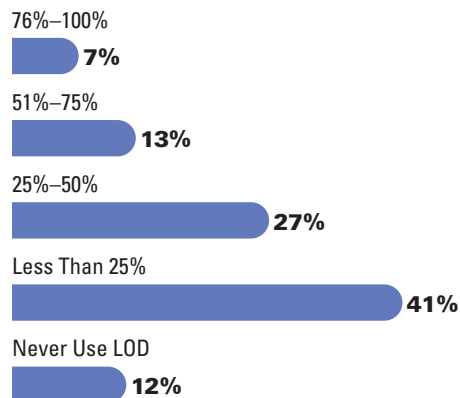
### Awareness of LOD in China (According to Small and Large Companies in China)

Dodge Data & Analytics, 2015



### Frequency of Use of LOD by the Chinese Companies Familiar With It

Dodge Data & Analytics, 2015



indicated having awareness of LOD.

- The largest percentage (41%) say they are using LOD on less than one quarter of their work.
- Only 20% say they use LOD more than half of the time.
- The average use of LOD across all the companies is on 29% of their projects.
- Among architects, the large firms show above-average use (37%).

## BIM Use

### Familiarity and Use of Level of Development (LOD) Standard CONTINUED

An encouraging sign is that the companies with higher BIM implementation levels also report greater use of LOD. As the chart shows, more than twice as many (33%) of the companies at high implementation levels use LOD more frequently than those at low implementation levels (16%). This suggests that LOD use may grow in proportion to expanding BIM implementation.

#### Future of LOD in the Global Construction Economy

Going forward it will be important for all architects and contractors to embrace LOD for enhanced model-based collaboration and integration, and to derive the benefit of BIM for improved outcomes for all parties. This will become especially important as more design and construction organizations expand beyond their national borders and work more frequently with foreign-based partners in their own countries.

#### LOD AND BUILDING PERFORMANCE ANALYSIS

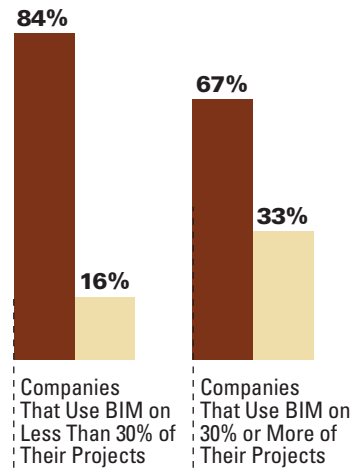
Understanding the LOD of a model also has a reciprocal relationship with the ability to perform building performance analysis, one of the most prominent ways in which the use of BIM can help support green building goals on a project. Models at a high level of development may contain building performance data, and inputting building performance data can help increase the information in (and therefore LOD of) the model. Therefore, a growing green market can help encourage wider use of LOD.

Dodge Data & Analytics (DD&A) calculates that the green building marketplace in the US increased fivefold between 2005 and 2008 and estimates that it will continue to grow at a significant pace. Additionally, DD&A revealed notable green building activity and plans around the world in the *World Green Building Trends SmartMarket Report (2013)*. As green building activity increases, understanding the different types of practices emphasized and incorporated into these projects becomes important for determining how best to reap both the financial and environmental benefits.

#### Use of Levels of Development (LOD) on Projects (By Level of BIM Implementation)

Dodge Data & Analytics, 2015

- Use LOD on Less Than Half of Projects
- Use LOD on More Than Half of Projects



## Levels of Development—or Equivalent—in the US, UK and China

**Enhancing the ability to collaborate is one of the main benefits of BIM, but knowing with certainty exactly what information received from others can be relied on is critical. However, the development of standards addressing this has been a challenge tackled differently across the globe.**

### LOD in the US

In 2008, the American Institute of Architects (AIA) released its first BIM contract document—AIA E202 Building Information Modeling Protocol Exhibit—which outlined five “levels of development” (LOD 100-500) for defining the amount of detail in a particular BIM model.

AIA’s important work set the stage, and it also helped reveal the next steps needed to make the levels of development more effective. The initial version included no graphical representations and no detailed description of them. They also generally followed traditional project phases that 3D design renders obsolete and did not push coordination and collaboration with all stakeholders earlier into the design process.

So began the long march toward defining model exchange using LODs, which define:

- Who is responsible for each element of the model and to what level of development?
- What are authorized uses for the model?
- To what extent can users rely on the model?
- Who will manage the model?
- Who owns the model?

In the US, the BIMForum, an interdisciplinary group of architects, engineers and construction professionals, has published a detailed specification for each level, including a new “permitting” level for regulatory review. It utilizes the

basic LOD definitions developed by the AIA and is organized by CSI Uniformat 2010.

### BIM Maturity Levels in the UK

The UK does not use the term LOD. Instead, they employ the BIM Maturity Diagram to illustrate various BIM maturity levels (0, 1, 2 and 3). Starting in the summer of 2012, the UK government began requiring that projects implement a Level 2 BIM at minimum, with all projects mandated for BIM use at that level for 2016.

“We have created a standard called PAS1192-2,” says Adam Matthews, head of EU & International Relations for the UK BIM Task Group. The Task Group was created by government initiative and brings together expertise from industry, government, public sector and academia to inform the industry about BIM. “[PAS1192-2] is a publicly available specification which [through] consultation with industry and government institutions create[s] a sensible and workable adoption of level 2 in terms of sharing of information ... It’s about creating exchange points between client and supply chain at key project stages.”

Despite similarities in the overall goals, there are also differences in the US and UK approaches. PAS1192-2 is a government mandate, whereas in the US, the LOD specification is being created voluntarily by architects, engineers, construction professionals and even trade contractors. While the UK

standard requires an assessment of a firm’s adoption of BIM, the LOD specification stresses that its definitions of development are model-specific and not a replacement for an individual BIM execution plan for each project.

### LOD in China

In China, the concept of defining levels of a project for hand-off in each stage was referenced in the 12th Five-Year Plan for Development of Construction Industry issued by the Ministry of Housing and Urban-Rural Development of the People’s Republic (MOHURD).

MOHURD calls BIM a key technology for information development in the Outline of Information Development of Construction Industry during 2011–2015. The report also requests that construction enterprises carry out research and apply BIM technology during the construction phase, which it considers to be the primary strategic goal.

Government support of the adoption of LOD for BIM could have strong implications. The total output of Chinese construction exceeded 13 trillion RMB in 2013, and mass adoption, via government mandate or otherwise, of a standard such as LOD could revolutionize China’s design and construction industries, supporting wider and more effective BIM use in this vast industry. ■

# Interview: Thought Leader

Professor Gu Ming  
Vice Dean of the School of Software  
Tsinghua University

**Professor Gu first encountered BIM in 2008 and believes that it is more than a design tool or 3D model. She has led her team in researching overseas experiences in BIM implementation and contextualized those experiences based on China's practical needs to support the development of CBIMS (China BIM Standards) since its conception.**

THE BUSINESS VALUE OF BIM IN CHINA

## **What do you think is the best way to encourage wider BIM adoption across the design and construction industry in China?**

**GU:** The best stakeholder to drive BIM is the owner, and the first thing to do is to integrate BIM as a prequalification requirement for consultants and contractors. Currently in China, Local Design Institutes and contractors can claim that they are using BIM and bid projects. [However,] the owner [needs to] insist that BIM is not just "good to have" but [that] the process and tool must be used to realize the intended values for the consultants and contractors to take BIM very seriously before they tender the project. This will then be a lesson learned and would change their attitudes about BIM, [which would] eventually diffuse to the entire ecosystem of the construction industry in China.

The GSA [General Services Administration] in the United States is a good example of driving [BIM use through] the owner. They update the rules of the game because they see the value BIM can bring to a project in terms of cost, time and quality. That is what needs to be done in China as well, starting with upstream education and mandates.

## **How has BIM impacted the design and construction industry in China?**

**GU:** BIM brings a revolutionary or even subversive transformation to

the industry, and the most critical impact is the enhancement of construction processes with a higher degree of digitization and integration of information. [This will] help form a truly industrial workforce. In the current China market, there is insufficient training to elevate the quality of construction workers to a level similar to the manufacturing industry. I think BIM is one of the means to train this workforce, and this transformation will be gradual.

## **What challenges does the China market present to wider BIM adoption?**

**GU:** The main challenge is to change the mindset of people from both the execution and management levels regarding the concept of digitization and leveraging of information technology in their practice, which is the same challenge the manufacturing industry faced 20 years ago.

The AEC industry in China is more conservative and closed-minded and perceives that some workflows and limitations of each discipline and trade are different from each other, and this conflicts with the spirit of collaboration. [Also,] marketing campaigns on BIM have not been able to really promote the transformation.

[Wider BIM adoption] requires a cultural shift from decision-makers to site workers levels. For example, decision-makers may believe that they are using BIM since they are

visualizing design through it, but [BIM use] is not just about spending some extra money with consultants or getting an internal team to perform model authoring. The same change in culture and mindset needs to happen with project managers, site engineers and site workers.

We also need to create the sense of urgency by letting [the industry] know that BIM is an inevitable trend. Companies and individuals need to get a head start instead of waiting it out; otherwise, the adoption is not going to progress. For software vendors, they need to package and customize BIM with the local culture, which is very different from the western countries. Continuing to promote BIM as a software tool will create a huge ongoing problem.

## **How do you think BIM will change the industry over the next five years?**

**GU:** BIM will elevate the level of standardization across the industry; [it will] allow more precise management of the construction process, and prefabrication will be further leveraged.

China will continue to go through an urbanization process in the next 20 years, and hundreds of millions of farmers will be moving into the city. How are we going to train or educate them to fit into this modern society? I believe the BIM industry can be a good option. ■



## China BIM Standard Development

**Recent government efforts to set BIM standards recognize the need for better articulation and documentation of design intent, increased control of project budgets and schedule, higher-quality construction, and more efficient government project approval and archiving with BIM.**

### Current BIM Standards in China

Both local and national governments in China have recognized the value of BIM standardization to promote BIM adoption. Supporting BIM standard development on a national scale, the China Academy of Building Research (CABR) and several other organizations established the China BIM Union in 2012, with goals of developing BIM standards, promoting BIM implementation and conducting research for the benefit of the national industry. With the support of many organizations, the Ministry of Housing and Urban-Rural Development of the People's Republic of China (MOHURD) has led the development of several national standards.

- **The Unified Standard** provides a wide range of general BIM standards for design and construction disciplines, covering topics including terminology, model structuring, information exchanges and interoperability, classification and coding, BIM deliverables, BIM storage and project management. The Unified Standard has primarily been developed by China BIM Union, in cooperation with major public and private organizations and research institutions, such as the China Association for Engineering Construction Standardization, China State Construction Engineering Corporation, Shanghai Construction Group and Tsinghua University.

- **The Classification and Coding Standard**, developed by the China Institute of Building Standard Design & Research, provides an organizational framework for standardizing the coding of building, design and construction components and processes, with reference tables for classifying design and construction disciplines, building spaces and elements, work results, phases, tools and processes.
- **The BIM Delivery Standard**, also developed by the China Institute of Building Standard Design & Research, includes contributions from many industrial organizations and academic institutions, over 40 organizations in all, and regulates Level of Development (LoD), cost estimation, BIM collaboration and information exchanges, and other BIM deliverable requirements with a focus on the design stage.
- **The Storage Standard** provides guidelines and processes for establishing information technology infrastructure to support BIM data management, and regularly archiving BIM data throughout the project lifecycle.

Alongside with the national BIM Standards, several cities such as Beijing and Shenzhen have started to develop BIM standards. The Beijing Municipal Commission of Urban Planning, in cooperation with Tsinghua University and major

local design civil design institutes, released the Beijing BIM Design Standard for Civil Building in 2014. This standard has popularized BIM technology and driven its rapid development, providing a model for other cities to develop their own standards.

### Using Standards to Encourage BIM Adoption

These standards will provide a mature foundation, yet more is needed to encourage BIM adoption throughout China. Increased BIM professional education and increased adoption of supporting technologies are important, but perhaps the most critical driver is the reformation of traditional processes at the project, enterprise and governmental levels to maximize the benefits of BIM. This includes restructuring workflows to increase project team integration and collaboration, reallocating resources and responsibilities to manage BIM, and systematizing the use of BIM throughout the facility lifecycle.

Addressing these challenges, universities are developing BIM training programs, and enterprises and educational institutions are driving BIM research. The government is also undergoing an extensive transformation under the administration of President Xi Jinping, making China more ready to embrace and step forward into the BIM revolution. ■

## Experience of Overall Value From BIM

The experience of value from BIM varies widely between users depending on their skill and experience, and the level of understanding and expectations they have about its achievable benefits.

### Perspectives of Chinese Architects and Contractors

Chinese architects and contractors were asked to select the one statement among the four listed in the chart that best describes their perspective on the current overall value of BIM for their company. **Approximately 60% of practitioners agree that they are getting a lot of value from BIM and that there is still more to be gained.** This is also the most common response from BIM users in all of the Dodge Data & Analytics BIM research studies around the world.

- **Architects feel more strongly about this (62%) than contractors (59%), with an especially enthusiastic vote from large architectural firms (72%).**
- **Small architectural firms, who generally are less engaged with BIM, weigh in below average (50%).**
- **Among contractors, a higher percentage of state-owned enterprises (68%) agreed with this statement than private ones (47%).**

**A larger proportion of contractors than architects feel they are just beginning to experience the value of BIM.**

This aligns with the finding that architects in general have more years of BIM experience and therefore have had the opportunity to experience more value. It also corresponds with the findings reported in *The Business Value of BIM in Australia and New Zealand SmartMarket Report*, where a higher percentage of contractors than architects also report that they are just scratching the surface on the value BIM can provide to them.

- **Private construction companies (42%) greatly outnumber state-owned ones (26%) in ascribing to this sentiment.**
- **Over a third (34%) of small architects feel this way, compared with only half as many (17%) of large architects.**

It is notable that nearly all of the respondents (94%) feel they are receiving at least some meaningful benefit from BIM, which is a very encouraging finding for a new technology and process.

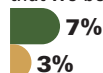
### Experience of Business Value From BIM

(According to Chinese Architects and Contractors)

Dodge Data & Analytics, 2015

- Architects
- Contractors

We're getting everything out of BIM that we believe it can provide us.



We're getting a lot of value from BIM but believe there is more to be gained.



We're just scratching the surface of how much value BIM can provide us.



We're getting no meaningful value from BIM.



## Business Benefits of BIM

Dodge Data & Analytics (DD&A) consistently focuses on the business benefits of BIM in its research because these are the key factors that drive a new technology or process to become widely accepted and standardized. This research differentiates between two main types of business benefits:

- **Internal Benefits** that accrue directly to the company deploying BIM
- **Project Benefits** that deliver a better, faster and/or less expensive end product for the owner

### Internal Benefits Generated by BIM

Chinese firms were asked to rate the degree to which they are receiving each of seven possible internal business benefits from BIM on a scale of one (no benefit) to five (very high benefit). Shown in the chart are the combined percentages of respondents who experienced a high or very high benefit from BIM.

One notable general trend is that a higher percentage of contractors than architects report each benefit. While, for the most part, the difference is not statistically significant, the trend suggests that higher levels of implementation for contractors yield more benefits.

#### ENHANCEMENT OF ORGANIZATION'S IMAGE AS AN INDUSTRY LEADER

BIM is a fast-growing and valuable new approach to project delivery that is attracting a lot of attention. Therefore it is natural that this ranks first overall as a direct benefit for the company using it.

- **Interestingly, it is cited highly by more contractors (71%) than architects (62%),** which corresponds with other findings that reveal Chinese contractors have a higher BIM implementation level than architects.
- **Among the contractors, an especially high percentage (88%) of those involved in institutional buildings named this as a highly valuable benefit,** perhaps indicating a growing demand among owners in that market.

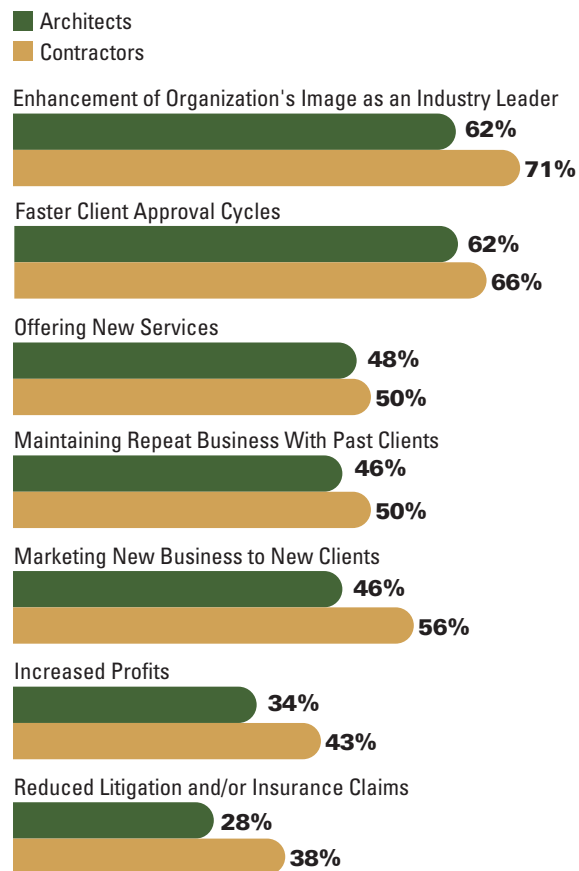
#### FASTER CLIENT APPROVAL CYCLES

This ranks very close to the top among internal BIM benefits because expediting a client's decision-making process is more efficient for everyone.

- **Large architects assign an above-average (69%) value to this benefit,** probably because their projects are typically larger and more complex, with lengthier decision-making cycles.

### Internal Business Benefits Generated by BIM (By Percentage of Chinese Companies Receiving Benefit at High or Very High Level)

Dodge Data & Analytics, 2015



## BIM Benefits

### Business Benefits of BIM CONTINUED

- **More of the contractors involved with industrial projects (74%) than building projects (59%) cited this**, perhaps indicating a greater value to expediting decisions on these projects.

#### **OFFERING NEW SERVICES, MAINTAINING REPEAT BUSINESS WITH PAST CLIENTS AND MARKETING NEW BUSINESS TO NEW CLIENTS**

These three benefits, which all fall into a general category of leveraging BIM capability to maintain and expand a business, are consistently rated highly by BIM users in the DD&A BIM research globally.

- **More private Chinese contractors (55%) rated maintaining business with repeat clients highly than did those from state-owned companies (45%).**
- **Offering new services was noted as highly valuable by more industrial/infrastructure contractors (70%) than buildings/interiors ones (46%),** perhaps pointing to more opportunity in those markets to leverage BIM for broader offerings.

#### **INCREASED PROFITS AND REDUCED LITIGATION AND/OR INSURANCE CLAIMS**

Although these benefits are rated lowest among the seven, they still score highly with over a third of BIM users.

- **More contractors than architects assign a high value to both of these benefits**, perhaps indicating their ability to leverage BIM for these purposes because of their generally deeper level of engagement.
- **Among the contractors, reduced litigation/claims is cited as a top benefit of BIM by far more working on industrial/infrastructure (65%) projects than buildings/interiors (22%),** pointing to the inherently higher risk associated with that work and emphasizing a critical benefit of BIM in mitigating it.

### **Internal BIM Benefits for Large and Small Architects**

A general trend in the findings of this research study is that larger firms in China are currently more engaged with BIM than their smaller peers. This is not unique to China; in fact, it is consistent across all the markets studied by DD&A.

The chart shows the differences between the percentage of large and small Chinese architects who report that their firms are receiving each of these BIM benefits at either a high or very high degree.

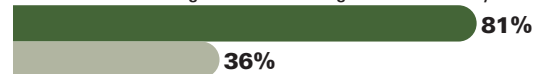
#### **Top Internal BIM Benefits**

(According to Large and Small Architects in China Receiving Benefit at High or Very High Level)

Dodge Data & Analytics, 2015

- Large Architects (800 Million or More RMB)
- Small Architects (Less Than 60 Million RMB)

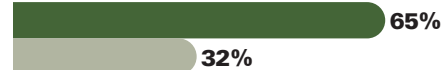
Enhancement of Organization's Image as an Industry Leader



Faster Client Approval Cycles



Offering New Services



Marketing New Business to New Clients



Maintaining Repeat Business With Past Clients



Increased Profits



Reduced Litigation and/or Insurance Claims





## BIM Benefits

### Business Benefits of BIM CONTINUED

- Because they are often pursuing high-profile work, the large architectural firms benefit more from the enhanced image, and can most effectively use that to market new business to major clients. With their resources they are also in the best position to offer new services. Additionally, because they tend to work on longer and more complex projects, the ability to expedite a client's approval process is understandably valuable.
- By contrast, smaller firms, because they do not pursue as much new business with new clients, show a greater preference for BIM's ability to help them maintain repeat business with their past clients. Interestingly, many more small architects are reporting increased profits and reduced problems after the project because of BIM.

#### Global Perspective on Internal Benefits for Contractors

In *The Business Value of BIM for Construction in Major Global Markets SmartMarket Report* (2014), contractors from 10 regions were asked to select their top three internal BIM benefits. Although that is a different rating system than the one to five rating conducted for this research, the comparison is useful for general trend analysis. The top six benefits identified by the contractors are shown in rank order in the matrix, including highest, lowest and average regional rankings. The ranking of these benefits by Chinese companies is included for comparison.

- All regions agree that the benefit of BIM capability enhancing the user organization's image is the top internal BIM benefit.
- Faster client approval cycles ranks #2 among Chinese contractors, yet ranks last for the other regions, which may point to an emerging benefit that other regions can learn to take advantage of.

#### Percentage of Contractors Citing Internal BIM Benefits as One of Top Three for Their Organization

China Data: Dodge Data & Analytics, 2015; Other Country Data: *The Business Value of BIM for Construction in Major Global Markets SmartMarket Report*, Dodge Data & Analytics, 2013

China Rank	Global Rank	Internal BIM Benefit	Highest Region	Global Average	Lowest Region
1	1	Enhancement of Organization's Image as an Industry Leader	Brazil 41%	32%	Japan 13%
3	2	Marketing New Business	South Korea 31%	19%	France 0%
6	3	Increased Profits	France 39%	14%	South Korea 7%
4	4	Offering New Services	South Korea 26%	14%	UK 7%
5	5	Maintaining Repeat Business	France 32%	13%	South Korea 4%
2	6	Faster Client Approval Cycles	Germany 22%	9%	US 6%

## Project Benefits Generated by BIM

Contractors and architects were asked to rate the degree to which each of 11 BIM benefits is improving their projects on a scale of one (no benefit) to five (very high benefit).

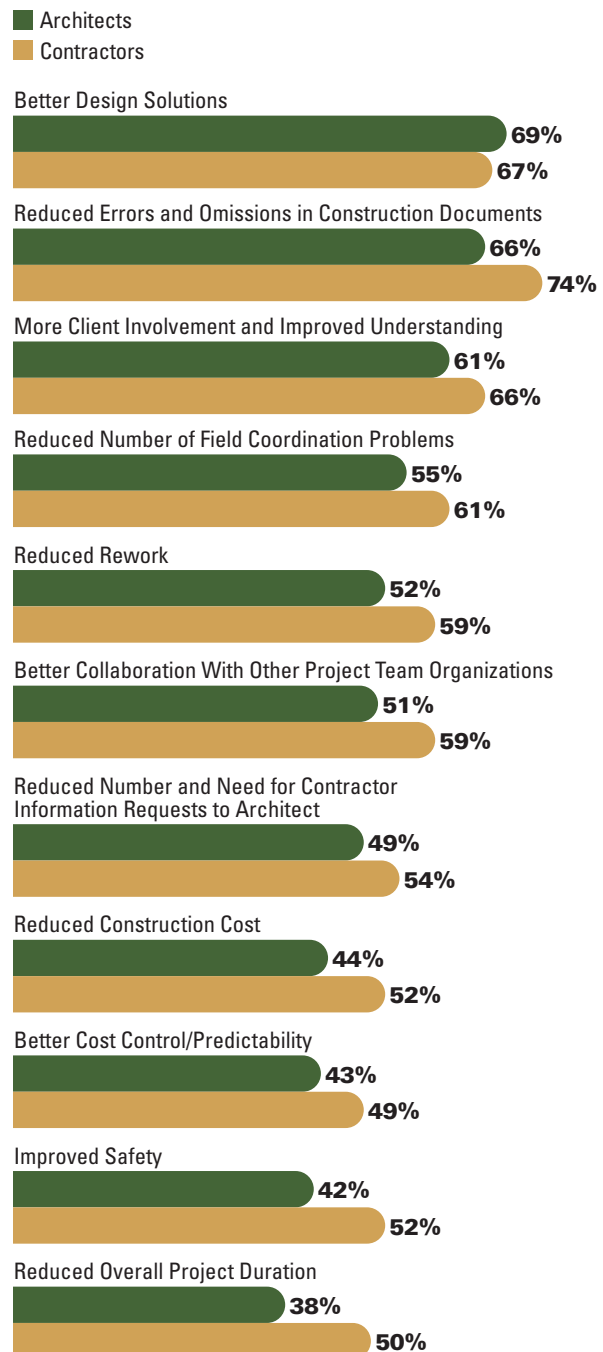
As with the internal benefits of BIM (see page 17), most of the project benefits are reported by a higher percentage of contractors than architects, again suggesting that the higher degree of implementation by contractors yields more benefits.

### Top Three Benefits Identified by Chinese Architects and Contractors

- **Better Design Solutions:** Both contractors (67%) and architects (69%) agree on the important contribution that BIM is making to delivering better projects for their clients.
  - An even greater percentage (87%) of large companies cite this as a top benefit, perhaps reflecting their higher level of commitment to BIM than smaller companies.
  - This finding is consistent with the findings in the *Business Value of BIM for Owners SmartMarket Report* (2014), in which the majority of BIM-experienced owners surveyed in the US and the UK expressed high or very high agreement with the statement that “BIM analysis and simulation capabilities produce a more well-reasoned design.”
- **Reduced Errors and Omissions in Construction Documents:** Contractors (74%) value this slightly more highly than architects (66%).
  - More (80%) large companies name this as a high-value benefit, probably because they tend to work on larger, more complex projects where errors and omissions can have a devastating impact on cost, quality and schedule.
  - Among contractors, far more state-owned firms (81%) rated this benefit highly than did private ones (64%).
  - The high rating by contractors is consistent with the findings of *The Business Value of BIM for Construction in Major Global Markets SmartMarket Report* (2014), which reports that reduced errors and omissions is the top-cited BIM project benefit by contractors around the world.
  - In the *Managing Uncertainty and Expectations in Building Design and Construction SmartMarket Report* (2014), design errors and omissions are cited as one of the top causes of uncertainty on projects,

### Project Benefits Generated by BIM (By Percentage of Chinese Respondents Receiving Benefit at High/Very High Level)

Dodge Data & Analytics, 2015



## BIM Benefits

### Project Benefits Generated by BIM

CONTINUED

which negatively impacts cost, quality and schedule, and BIM is identified as a successful mitigating strategy for reducing the incidence and severity of design errors and omissions.

■ **More Client Involvement and Improved Understanding:** This benefit is also favored by slightly more contractors (66%) than architects (61%).

- In the *Managing Uncertainty and Expectations in Building Design and Construction SmartMarket Report* (2014), increased owner involvement throughout the project is cited by architects and contractors as the most effective factor to mitigate uncertainty and align expectations for the benefit of all team members.
- The exceptional visualization power of BIM is a potent means to involve owners and improve their understanding. In *The Business Value of BIM for Owners SmartMarket Report* (2014), the top-rated benefit statement by all surveyed owners is "BIM visualization enables a better understanding of proposed design."

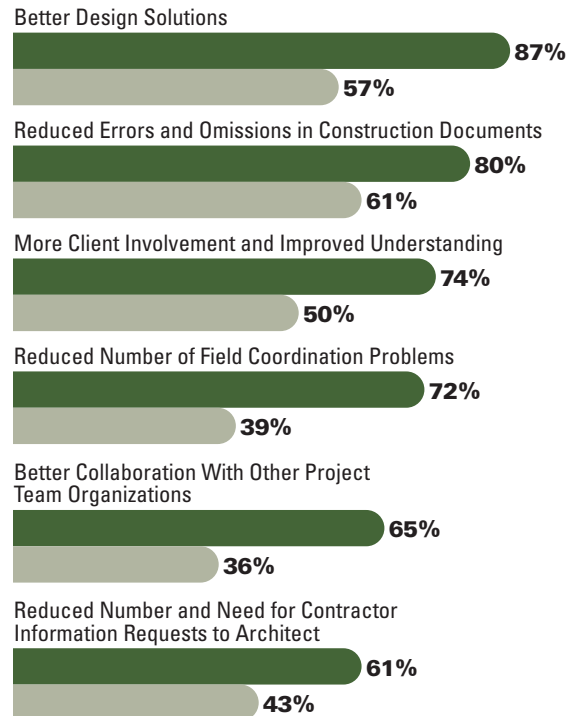
Other highly rated project benefits in China listed in the chart on page 20 relate to several key themes.

- **Reduced Number of Field Coordination Problems; Reduced Rework:** The effectiveness of model-based spatial coordination leads to greatly improved efficiency on the project site, allowing teams to model what they will build and to build what they have modeled.
- **Better Collaboration With Other Project Team Organizations; Reduced Number and Need for Contractor Information Requests to Architect:** More integration and effective sharing of information between all project team members helps to improve mutual understanding and reduce uncertainty.
- **Reduced Construction Cost; Better Cost Control/Predictability:** The ability to predict and control costs more effectively through BIM reduces the chance of unanticipated cost overruns and helps a project stay on budget. More sophisticated users of BIM have the ability to actually reduce a project's construction cost through model-driven processes like prefabrication and by applying lean principles that are facilitated through BIM.
- **Improved Safety:** Safety problems are often related to special "workaround" activities caused by coordination problems and by the rework required to replace incorrect work. Therefore, as BIM reduces the incidence of coordination problems and rework, it also improves safety. Safety also improves as more prefabrication

### Project Benefits Generated by BIM for Large and Small Chinese Architects

Dodge Data &amp; Analytics, 2015

- Large Architects (800 Million or More RMB)
- Small Architects (Less Than 60 Million RMB)



work is done offsite and near-site in safer conditions, which requires less labor at the site. Interestingly, more of the small Chinese companies (57%) report experiencing this benefit at a high level than large ones (28%), in contrast to the general tendency toward higher reporting of benefits by large firms.

- **Reduced Overall Project Duration:** Although relatively low among benefits for Chinese firms, reduced overall project duration ranks sixth out of 11 project benefits identified by contractors in *The Business Value of BIM for Construction in Major Global Markets SmartMarket Report* (2014). This may indicate that Chinese firms can expect to see growth in their experience of this benefit as their implementation of BIM increases.

## BIM Benefits

### Project Benefits Generated by BIM

CONTINUED

#### Project BIM Benefits for Large and Small Architects

Focusing just on six project benefits that have a particularly high impact on architects, the chart shows the differences between the percentage of respondents from large and small Chinese architectural firms who report that BIM is improving their projects in each of these six ways to either a high or very high degree.

- **Large firms significantly outpaced small firms on every project benefit**, probably reflecting their generally deeper level of engagement with BIM.
- **One key difference between large (65%) and small (36%) firms is for the benefit of better collaboration with other project team organizations.** This is probably because the larger firms work on more complex projects with more team members, and therefore have enjoyed this benefit to a far greater degree.
- **Other differences, such as reduced number of field coordination problems, are probably influenced by the relative complexity of large firms' projects, where the risk of such problems is higher and more impactful.**

#### Global Perspective on Project Benefits for Contractors

In *The Business Value of BIM for Construction in Major Global Markets SmartMarket Report* (2014), contractors from 10 regions were asked to select their top three project benefits from BIM. Although that is a different rating system than the one to five rating used in this study, the comparison is useful for general trend analysis.

The top seven benefits identified by the contractors in the global research are shown in rank order in the matrix, including highest, lowest and average regional rankings. The ranking of these benefits by Chinese companies is included for comparison. However, several of the project benefits studied in this research were not included in the Global Contractor BIM study, so for comparison purposes, the China ranking in the matrix refers only to ranking among the seven project benefits that were included in both research studies.

- **All regions agree that the benefits of reduced errors and omissions in construction documents, better team collaboration, reduced rework and reduced construction cost are the top four ways that BIM is benefiting their projects.**
- **Chinese contractors rank the benefit of improved safety higher than the average of other regions, which may support a future role of global leadership in that area.**

#### Percentage of Contractors Citing Project BIM Benefits as One of Top Three for Their Organization

China Data: Dodge Data & Analytics, 2015; Other Country Data: *The Business Value of BIM for Construction in Major Global Markets SmartMarket Report*, Dodge Data & Analytics, 2013

China Rank	Global Rank	Internal BIM Benefit	Highest Region	Global Average	Lowest Region
			South Korea		France
1	1	Reduced Errors and Omissions in Construction Documents	63%	41%	13%
			US		Japan
2 (tie)	2	Better Collaboration With Other Project Team Organizations	45%	35%	20%
			US		Germany
2 (tie)	3	Reduced Rework	40%	31%	3%
			Brazil		Japan
4 (tie)	4	Reduced Construction Cost	46%	23%	13%
			Germany		South Korea
7	5	Better Cost Control/Predictability	44%	21%	11%
			Germany		South Korea
6	6	Reduced Overall Project Duration	38%	19%	10%
			Germany		US
4 (tie)	6	Improved Safety	22%	7%	2%

- **The benefit of cost control and predictability is more highly ranked by the other regions, which may point to an opportunity for Chinese contractors to learn from the experiences of their global peers.**



## Factors That Impact BIM Benefits

Chinese contractors and architects were asked to rate a variety of factors for how each would improve the benefits they are receiving from BIM. The charts show what percentage of users said that a factor would either have a high or very high positive impact. The responses for large and small companies are shown separately as a way to highlight the impact of the generally greater level of BIM engagement reported by large companies.

The factors are divided into two groups:

- **Market and Industry Factors**, such as BIM skills, demand for BIM and validation of its value
- **Technical and Process Factors**, such as software interoperability and functionality, data mobility, 3D content and modeling standards

### Market and Industry Factors That Would Improve BIM Benefits

#### MORE STAFF WITH BIM SKILLS

The fact that this ranks as the top factor in China for all respondents is a direct reflection of the fast growth of BIM and the resulting high demand for skilled BIM talent.

- **The big disparity between small companies and large ones indicates the more rapid pace at which the larger firms are expanding their BIM implementation.**
- **This finding should be an important message to training and education providers that serve the design and construction industry in China about the demand for training.**

#### MORE HARD DATA DEMONSTRATING BIM'S BUSINESS VALUE

Ranking second overall, this speaks to the natural desire for companies to understand more of the quantitative benefits of a new technology and process to help justify the investment in BIM and be able to measure the benefits.

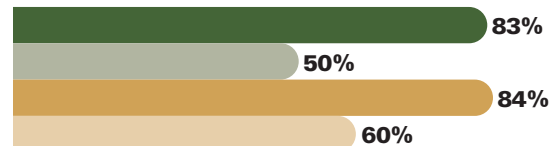
- **The highest demand for this is coming from the large architectural firms (83%).** Since architects initially author the models that are required to have a BIM-based process, they are under pressure to expediently convert their organizations from CAD-based systems to BIM.
- **Contractors are somewhat less concerned (66% average) than architects.** This aligns with findings from *The Business Value of BIM in Australia & New Zealand SmartMarket Report* (2014), which showed that 58% of architects from Australia and New Zealand cited this as an important factor, yet only half as many (29%) contractors from that region concurred.

### Market and Industry Factors Most Likely to Increase BIM Benefits for Users in China

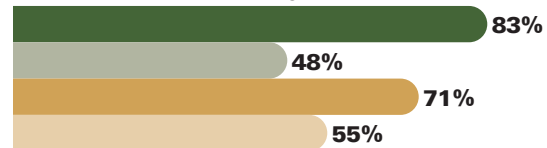
Dodge Data & Analytics, 2015

- Large ARCHITECTS (800 Million or More RMB)
- Small ARCHITECTS (Less Than 60 Million RMB)
- Large CONTRACTORS (800 Million or More RMB)
- Small CONTRACTORS (Less Than 60 Million RMB)

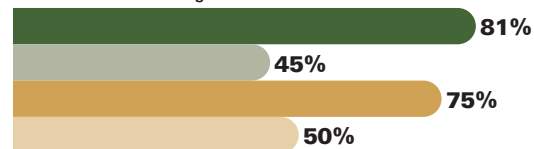
#### More Staff With BIM Skills



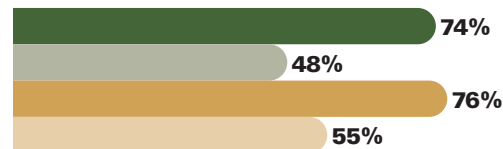
#### More Hard Data Demonstrating BIM's Business Value



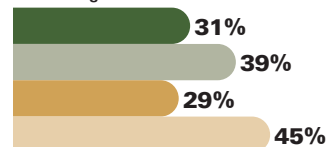
#### More Owners Asking for BIM



#### More External Firms With BIM Skills



#### More Readily Available Outsourced Modeling Services



#### MORE OWNERS ASKING FOR BIM

Increased demand from owners is consistently identified in all Dodge Data & Analytics (DD&A) BIM research globally as a critical factor. This factor aligns with the need for more hard data on the benefits of BIM, but with a special focus on its advantages for owners.

## BIM Benefits

### Factors That Impact BIM Benefits CONTINUED

#### MORE EXTERNAL FIRMS WITH BIM SKILLS

While this factor scores slightly lower with all respondents than internal BIM skills, it is still very highly rated. This makes sense because as companies become more deeply engaged with BIM, they realize that, while at first it was important for their firm to master BIM skills, the true power of BIM is in the collaborative efforts of multiple firms working together and efficiently sharing model-based data. As a result, the need for more of the companies working together on projects to have adequate BIM skills becomes increasingly apparent and urgent.

#### MORE READILY AVAILABLE OUTSOURCED MODELING SERVICES

Outsourced modeling services are a natural resource if internal staff or project team members are not adequately staffed to support BIM. The smaller companies in China are expressing greater demand for these services than the larger ones. This likely reflects their relative lack of internal resources versus the larger organizations that are already working on building internal BIM capabilities.

#### Technical and Process Factors That Would Improve BIM Benefits

As was true in the results for market and industry factors, the larger companies in China generally express a greater degree of belief in the potential positive impact of the technical and process factors on their benefits from BIM.

#### IMPROVED INTEROPERABILITY BETWEEN SOFTWARE APPLICATIONS

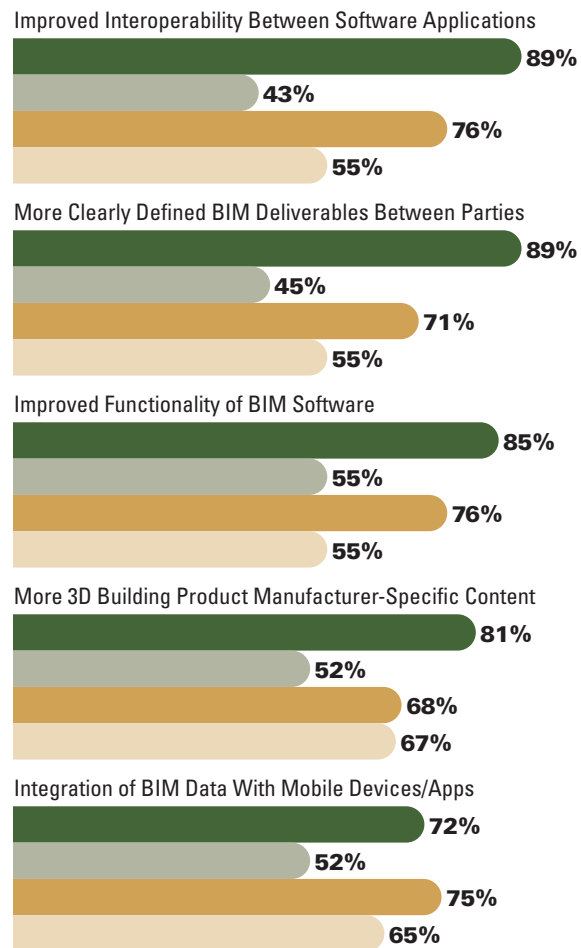
Since 2007, DD&A has been studying the problem of interoperability between technologies in the design and construction industry. While improvements have been made in data standards that enable exchange of datasets (such as IFC), many practitioners still cite the lack of interoperability as a major challenge.

- Consistent with these China results, a large percentage of architects and contractors globally express the belief that improved interoperability will enhance their benefits from BIM.
- The higher results from the larger Chinese companies likely reflect their greater experience with collaborative BIM-based processes on their larger and more complex projects, therefore raising their awareness of the need for better interoperability.

#### Technical and Process Factors Most Likely to Increase BIM Benefits for Users

Dodge Data & Analytics, 2015

- Large ARCHITECTS (800 Million or More RMB)
- Small ARCHITECTS (Less Than 60 Million RMB)
- Large CONTRACTORS (800 Million or More RMB)
- Small CONTRACTORS (Less Than 60 Million RMB)



#### MORE CLEARLY DEFINED BIM DELIVERABLES BETWEEN PARTIES

In another direct example of the growing importance of collaborative BIM processes, Chinese architects and contractors cite more clearly defined deliverables between parties as the second most important factor that would improve BIM benefits.

## BIM Benefits

### Factors That Impact BIM Benefits CONTINUED

- **Large architects lead in their rating of this factor**, reflecting their prominent role in authoring models that are then exchanged among other parties for specific workflows. The need for these models to reliably contain specific information is essential to support effective collaboration and efficiency.
- **The Level of Development (LOD) standard (described on pages 11 and 13) is an important element to more clearly defining deliverables between parties.**

#### IMPROVED FUNCTIONALITY OF BIM SOFTWARE

This is the factor most highly rated by smaller architects, likely indicating their current focus on building initial internal BIM skills. Over time it can be expected that these firms will shift focus to more of the collaboration-oriented factors cited by large companies.

#### MORE 3D BUILDING PRODUCT MANUFACTURER-SPECIFIC CONTENT

All DD&A BIM research consistently finds more 3D building product manufacturer-specific content important. Industry practitioners in China need to work with building product manufacturers to have them create and make available this type of content with proper attributes and appropriate geometric information.

#### INTEGRATION OF BIM DATA WITH MOBILE DEVICES/APPS

This factor is cited by the largest percentage of small contractors, likely reflecting their tendency to have minimal office staff and their need to travel a great deal in support of a higher number of concurrent smaller projects, rather than having several staff members positioned at a single site for a large project.

## Single Most Important Thing About BIM

All respondents were asked to identify, with no responses or prompts provided, what they believe is the single most important thing about BIM. The answers were analyzed and then aggregated around major themes. The matrix shows the differences between the responses of architects and contractors.

- **The top focus for architects is bringing more structure to the BIM process through standardization and regulation**, thereby enabling them to produce better project documentation with BIM.
- **Contractors are focused on building the project; therefore improved quality and accuracy is naturally their top benefit, followed by efficiency and convenience.**
- **Cost/Profit ranks second for architects**, which indicates a focus on recovering the cost of implementing BIM through profit enhancement.
- **All the respondents include the need to drive better integration with management systems, and to expand BIM awareness and usage among their top five most important things about BIM;** these sentiments are echoed by BIM users everywhere in Dodge Data & Analytics' previous BIM studies globally.

#### Top Selections of the Single Most Important Thing About BIM

(According to Chinese Architects and Contractors)

Dodge Data & Analytics, 2015

Top Five for Architects	Top Five for Contractors
1. Standardization/Regulation	1. Improve Quality/Accuracy
2. Cost/Profit	2. Efficiency/Convenience
3. Efficiency/Convenience	3. Project Management/ System Integration
4. Increase BIM Awareness/Usage	4. Increase BIM Awareness/Use
5. Project Management/ System Integration	5. Cost/Profit

# Efficient Project Delivery of a Skyscraper With BIM

## Shanghai Tower

SHANGHAI, CHINA

Shanghai Tower will be the tallest building in the Pudong skyline and in China.



Currently under construction, Shanghai Tower is a 121-story super high-rise anticipated to become a thriving office and commercial center with a luxury hotel. It will soon stand as the tallest and most sustainable skyscraper in China—and the world's second tallest building at 632 meters. BIM has been used throughout the project to improve efficiency, reduce errors and streamline collaboration among large and diverse project teams.

The twisting curtain wall design and fabrication, and the sheer size of the tower, present complex design and construction management challenges. "The Shanghai Tower is a massive project with 576,000

square meters of building space," says Qing Ge, chief engineer and vice general manager for Shanghai Tower Construction & Development Co., Ltd. "The project complexity would be very difficult to manage successfully with traditional project delivery methods and systems."

### BIM Core Team

BIM played an important role during the design stage for building form definition, structural and energy simulations, and curtain panel rationalization.

Early in the project design process, a BIM project manager was appointed by the owner to define contractual BIM requirements and monitor project stakeholders'

performance. As the project progressed to the construction stage, a three-person BIM core team formed to oversee BIM implementation and monitor its impact on overall project delivery and schedule conformance. The BIM core team also managed BIM knowledge and process improvement, reflecting upon lessons learned during early project phases to refine the BIM deliverables and expectations within later subcontractor agreements.

### Enhanced Global Collaboration

BIM provides the global team, consisting of nine teams from China and abroad, an effective and



## Shanghai Tower

### SHANGHAI, CHINA

stats

#### Project Facts and Figures

##### Owner

Shanghai Tower Construction & Development Co., Ltd.

##### Engineer

Thornton Tomasetti

TJAD

##### Architect

Gensler

##### General Contractor

Shanghai Construction Group

##### Type of Project

Mixed-Use Super High-Rise

##### Size

576,000 square meters

##### Estimated Completion

2015

##### Project Cost

14.8 Billion RMB

##### BIM-Enabled Benefits

- Accumulated rework so far is less than .22% of total project cost
- Construction schedule compressed to 73 months

efficient means of collaboration. The global project team not only coordinated designs and delivered the project with BIM, but also effectively transformed collaborative behaviors and BIM practices among international design firms, local design institutes and general and specialty contractors.

### Reduce Rework and Schedule

Since the beginning of construction, Mr. Ge's team has been tracking rework from "passive change," due to documentation errors and/or lack of coordination. As of early 2014, the accumulated rework cost is less than 0.22% of total project cost.

The control and mitigation of rework across the entire project has allowed it to be managed with a staff of 15 people, much lower than the typical management staff of 50 for another project of similar or smaller size. BIM also contributed to the compressed construction schedule of 73 months for 576,000 square meters, around 30% faster than 70 months for a typical high-rise project of 380,000 square meters.

### BIM for Facility Management and Operations

After construction is complete, BIM will still play a vital role for the Shanghai Tower. Mr. Ge states, "We are planning to use BIM to support operations, but it is critical to understand what the operation team and processes most need to enhance." He mentions, as an example, that BIM may be able to support asset management and space management, where he

thinks the use of BIM may be able to "provide higher-quality information and improve building service."

He also sees wider applicability for the model in terms of a broader vision for Shanghai as a city of the 21st century. "More forward looking [into BIM for operations] would be connecting the Shanghai Tower BIM with concepts like intelligent buildings, intelligent hotels and intelligent cities."

The team has been researching various case studies around the world and is planning to engage solution vendors in developing a customized BIM for operations platform. "The extent and depth of BIM's application are dependent on the level of development and maturity of the models. Therefore, in the initial phase we will limit the application of BIM to certain locations or zones to better understand the demand on computer systems of BIM for facility management and the impact on staff training and capabilities," says Ms. Sujing Duan, BIM project supervisor.

### Developer Commitment

Despite most of the project stakeholders using BIM for their respective scope and delivery, the relevant department submission process relied on conventional methods used by other non-BIM projects. Mr. Ge states, "We cannot ask for change overnight—this paradigm shift takes time. [By the end, though,] the involved consultants and contractors have changed from users to believers, and they are not turning back." ■

## Perceived ROI for BIM

Although there is no single globally accepted method to calculate the return on investment (ROI) for BIM, most users have a perception of the degree to which they are receiving value for the time, money and effort they have invested.

BIM users in China were asked to select one of seven options describing their perception of the ROI they have seen from their investments in BIM, which each fall into one of three categories.

- **Negative:** The value they have received so far is less than the investments they have made.
- **Break-Even:** The value they have received is approximately equivalent to the investments they have made.
- **Positive:** They feel they are receiving greater value than the investments they have made.

The findings demonstrate an overall positive perception of BIM ROI:

- **Only a small percentage of users (14%–15%) believe they are still at a negative ROI.**
- **A higher percentage of contractors experience a positive ROI than architects,** probably because they generally receive a greater share of the financial benefits of BIM (e.g., reduced rework, increased profits).

Among architects, size of firm has a direct relationship to perceived ROI on BIM:

- **An above-average percentage of large firms (51%) report positive ROI.**
- **About half (49%) of small firms perceive that they are just breaking even.**

### ROI by BIM Implementation Level

Companies at low levels of BIM implementation typically experience negative or break-even ROI on their BIM investments, especially smaller organizations for which it takes longer to absorb the initial costs of software, hardware, training and development of content and business processes to support BIM. However, BIM users naturally improve their ROI over time as they complete more projects, expand their skills and experience, and amortize the initial costs of getting established with BIM.

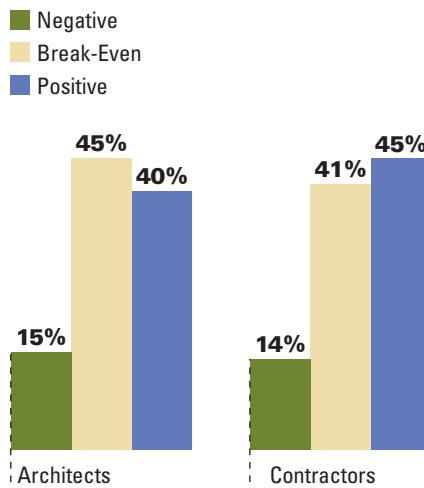
The chart shows ROI reported by users at three levels of BIM implementation:

#### LOW (LESS THAN 15% OF THEIR PROJECTS INVOLVE BIM)

- These companies are roughly equal in proportions of negative (29%), break-even (41%) and positive (30%).

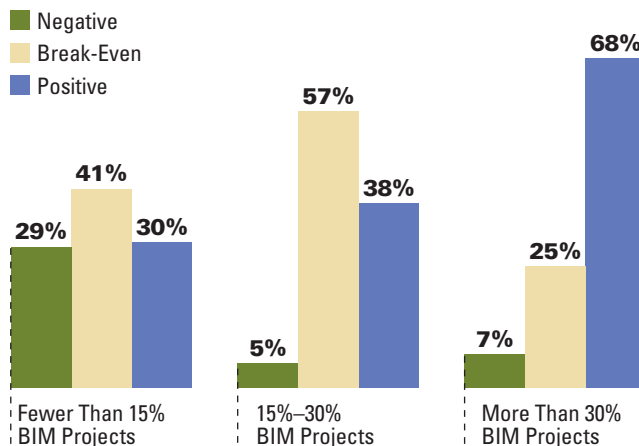
### Perceived Return on Investment (ROI) for BIM Users in China

Dodge Data & Analytics, 2015



### Perceived Return on Investment (ROI) for BIM Users in China (By Level of BIM Implementation)

Dodge Data & Analytics, 2015



- This breakdown is a natural result of the early-stage learning curve required for BIM, although it is important to note that even at this low level of implementation, over two thirds of users are break-even or positive.

## BIM ROI

### Perceived ROI for BIM CONTINUED

#### MODERATE (BETWEEN 15% AND 30% OF THEIR PROJECTS INVOLVE BIM)

- Once users reach a moderate level of implementation, the percentage experiencing negative ROI drops dramatically to just 5%. This shows that it does not take long for users to shift from negative to break-even ROI.
- The group with positive ROI increases, but just slightly, to 38%. This reflects that increased commitment (beyond a moderate level) is required for most firms to reach this desired level of ROI.

#### HIGH/VERY HIGH (MORE THAN 30% OF THEIR PROJECTS INVOLVE BIM)

- It is at this level that commitment clearly pays off, with over two thirds (68%) reporting positive ROI.
- This supports the global trend reported in *The Business Value of BIM for Construction in Major Global Markets SmartMarket Report* (2014), where half of the contractors at a very high engagement level from 10 regions reported extraordinary ROI in excess of 25%.

## Formal Measurement of BIM ROI

Many companies around the world conduct formal measurement of their ROI on BIM at a project level in order to assess their overall ROI against their total investment at their company level. Chinese architects and contractors were asked on what percentage of their projects their company formally measures its ROI on BIM.

- **Most Chinese companies say they are measuring BIM ROI, but the majority of those are only conducting measurements on less than 50% of their projects.**
- **A higher percentage of architects than contractors do not measure ROI, perhaps because measuring quantitative performance results (such as labor productivity and safety) is generally more common among contractors.**

Additional analysis reveals more trends related to the frequency of measuring BIM ROI.

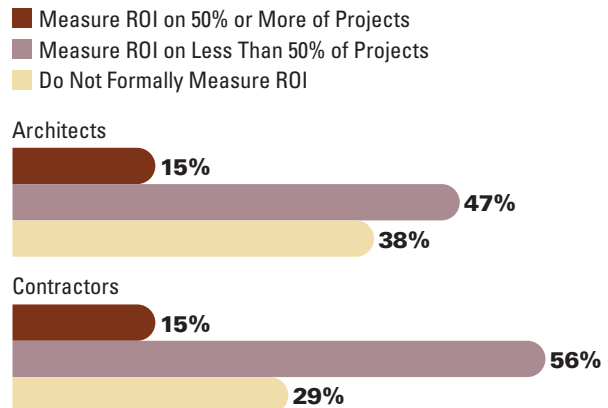
- **Measuring BIM ROI is a relatively recent activity.**
  - Over half of architects (54%) and more than two thirds of contractors (67%) report only one year to two years' experience doing measurements.
  - Only about a third of architects (34%) and even fewer contractors (29%) claim more than two years' experience.
- **Firm size is important for architects measuring ROI.**
  - 41% of large firms are doing measurements on more than half their projects, versus only 10% of small firms.
  - Many more large architects (47%) have over two years' experience measuring BIM compared with the average for all architects (34%).

### Factors Impacting the Frequency of Formally Measuring BIM ROI

Two factors relate directly to the frequency of measuring ROI.

#### Frequency of Formally Measuring BIM ROI in China

Dodge Data & Analytics, 2015



#### ■ ROI measurement frequency increases with BIM implementation level.

- Half of the companies highly engaged with BIM (greater than 30% implementation level) are formally measuring ROI on most of their projects.
- That frequency drops to 11% for the companies at a moderate BIM implementation level and only 3% at the lowest implementation level, where, in fact, most companies (61%) are never measuring their ROI.
- **Increased frequency of measuring ROI relates directly to higher levels of perceived ROI.**

- Less than one third (31%) of companies that report a negative ROI are actually measuring it, and only a tiny fraction (3%) measure it on the majority of their projects. Thus, most of the respondents reporting negative ROI are not basing their judgment on empirical evidence.
- Conversely, 81% of users reporting positive ROI measure it on at least some portion of their projects, and 28% do so on the majority of projects. This provides a reasonable basis for their positive ROI.

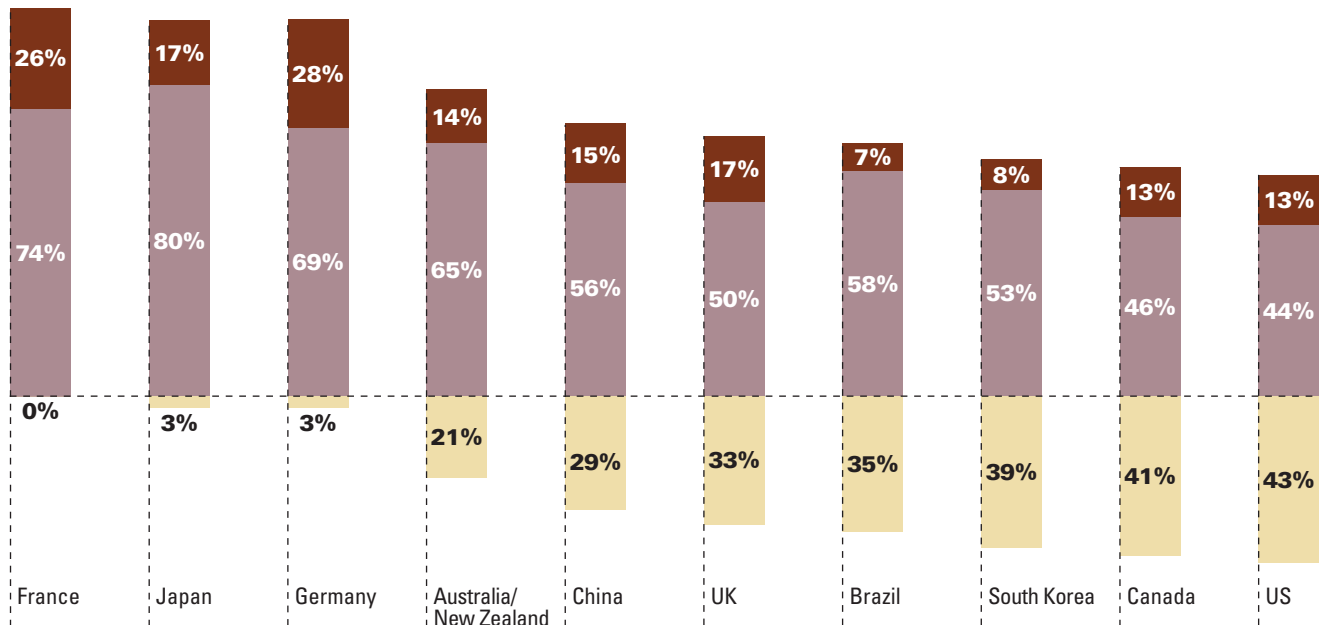
### Global Comparison of Contractors' Frequency of Measuring BIM ROI

In *The Business Value of BIM for Construction in Major Global Markets SmartMarket Report* (2014), contractors from 10 global regions were asked about their frequency of formally measuring BIM ROI. **Chinese contractors are in the middle of the range for frequency compared with their global peers.** As a general trend, companies that measure more also report higher overall ROI.

### Measurement of BIM ROI (By Country)

China Data: Dodge Data & Analytics, 2015; Other Country Data: *The Business Value of BIM for Construction in Major Global Markets SmartMarket Report*, Dodge Data & Analytics, 2013

- Measure ROI on 50% or More of Projects
- Measure ROI on Less Than 50% of Projects
- Do Not Formally Measure ROI



### Impact of Factors on Frequency of Formally Measuring BIM ROI in China

Dodge Data & Analytics, 2015

- Do Not Formally Measure ROI
- Measure ROI on Less Than 50% of Projects
- Measure ROI on 50% or More of Projects

#### By BIM Implementation

More Than 30% BIM Projects



15%–30% BIM Projects



Fewer Than 15% BIM Projects



#### Perception on ROI

Positive ROI



Break-Even ROI



Negative ROI



## Top Benefits That Would Contribute to Increasing BIM ROI

Chinese architects and contractors were shown a list of BIM benefits and asked to rate how much an increase in each one would directly improve their company's ROI on BIM, on a scale of 1 (no impact) to 5 (very high impact). Shown in the two charts on pages 31 and 32 are the combined percentages of the top two ratings (high impact or very high impact) in each case.

The benefits are divided into two types:

- **Processes Improvements:** Enhancements to ongoing processes, such as better communication and faster cycle times for specific activities
- **Outcome Improvements:** Measurable impacts of having completed a project using BIM, such as improved safety, lower cost or higher productivity

### Processes Improvements That Would Increase ROI for BIM

The rank ordering of the impact of this category of benefits is the same between architects and contractors, although a higher percentage of contractors provide top ratings in each case, perhaps indicating a greater intensity of desire for them.

#### BETTER MULTI-PARTY COMMUNICATION FROM 3D VISUALIZATION

This benefit, which rates highest across both process and outcome categories with both Chinese architects and contractors, also consistently scores very strongly in all Dodge Data & Analytics' BIM research around the world.

Supporting evidence is shown in *The Business Value of BIM for Owners SmartMarket Report* (2014), where leading owners in the US and UK cited a top benefit of BIM to be that "BIM visualization enables a better understanding of proposed design" and stated the belief that "better team coordination/collaboration" is BIM's single greatest benefit.

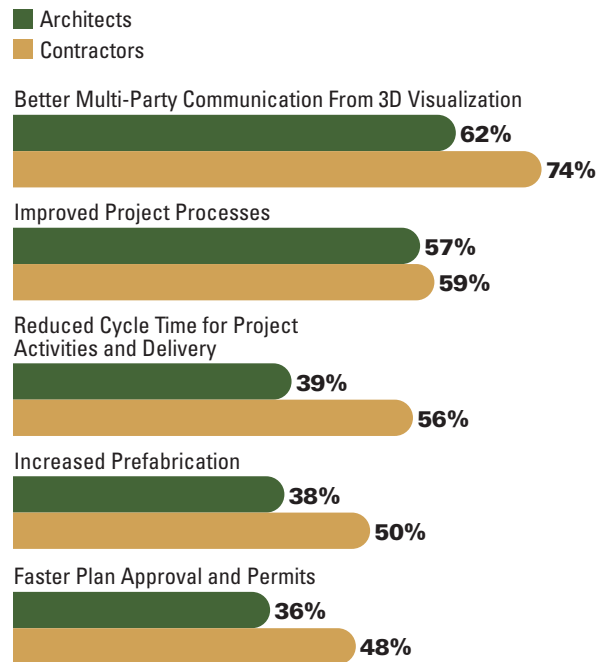
#### IMPROVED PROJECT PROCESSES; REDUCED CYCLE TIME FOR PROJECT ACTIVITIES AND DELIVERY; FASTER PLAN APPROVAL AND PERMITS

These three benefits reinforce each other to improve the overall efficiency of the project delivery process.

Certain government programs such as the CORENET e-Plan Check in Singapore are specifically focused on using BIM to streamline the plan approval process.

### Processes Improvements That Would Increase ROI for BIM (Percentage of Users in China Citing High/Very High Impact)

Dodge Data & Analytics, 2015



#### INCREASED PREFABRICATION

This is one of the fastest-growing trends related to BIM, especially in markets where there is a relatively high level of trade contractor BIM proficiency to implement the activity.

Findings from *The Business Value of BIM for Construction in Major Global Markets SmartMarket Report* (2014) show that model-driven prefabrication is the second most frequent BIM activity during the construction phase among contractors in the 10 global regions studied. This is an opportunity for Chinese contractors to take advantage of a growing global trend.



### Outcome Improvements That Would Increase ROI for BIM

The rank ordering of the impact of this category of benefits is very close to the same among architects and contractors. However, as with process improvements, a higher percentage of contractors provide top ratings in each case, emphasizing a possible greater intensity of desire for increases in these benefits.

#### POSITIVE IMPACT ON SUSTAINABILITY

While the increasing focus on green building around the world may be a strong influence on this stated need from both architects and contractors in China, its relatively strong performance in China may also be driven by China's own sustainability efforts. In order to address pollution issues, China has made green building investments at a relatively aggressive pace. In addition, green building efforts play an important role in China's efforts to address CO<sub>2</sub> emissions.

Contractors from 10 global regions surveyed for *The Business Value of BIM for Construction in Major Global Markets SmartMarket Report* (2014) report using BIM for a variety of sustainability-related activities, such as coordinating building systems to improve energy performance, and creating tighter building envelopes through BIM-enhanced prefabrication.

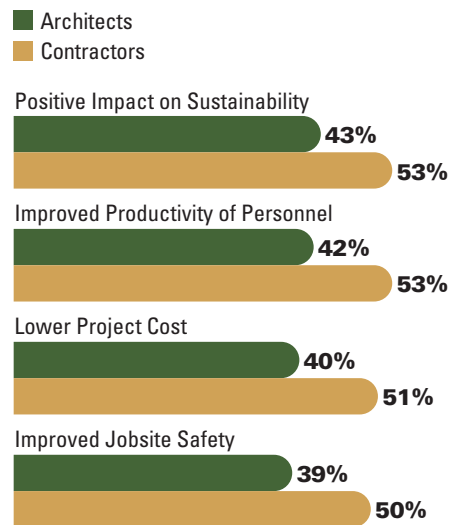
#### IMPROVED PRODUCTIVITY OF PERSONNEL; LOWER PROJECT COST; IMPROVED JOBSITE SAFETY

It is natural that these quantifiable measurements are rated more highly by contractors, who are held directly responsible for them.

A number of US-based contractors are actively tracking labor productivity, cost and safety metrics, especially from projects with extensive use of model-driven prefabrication. (See Resources section on page 57 for a link to BIM metrics published by Mortenson, a large US contractor.)

### Outcome Improvements That Would Increase ROI for BIM (Percentage of Users in China Citing High/Very High Impact)

Dodge Data & Analytics, 2015



### Global Contractors' Perspectives on Benefits That Would Most Increase BIM ROI

As part of the research for *The Business Value of BIM for Construction in Major Global Markets SmartMarket Report* (2014), contractors in 10 global regions were asked to select the three benefits that, if increased in frequency for them, would most improve their BIM ROI. This is a different survey approach than was taken for this China research, where respondents were asked to rate each benefit on a 1–5 scale, but the comparison is useful to reveal general global trends.

The chart shows the highest and lowest regions as well as the average among all 10 regions for the top five highest-rated benefits globally. The percentage of Chinese contractors giving a high or very high impact rating is also shown on the scale.

Trends that appear in the findings include:

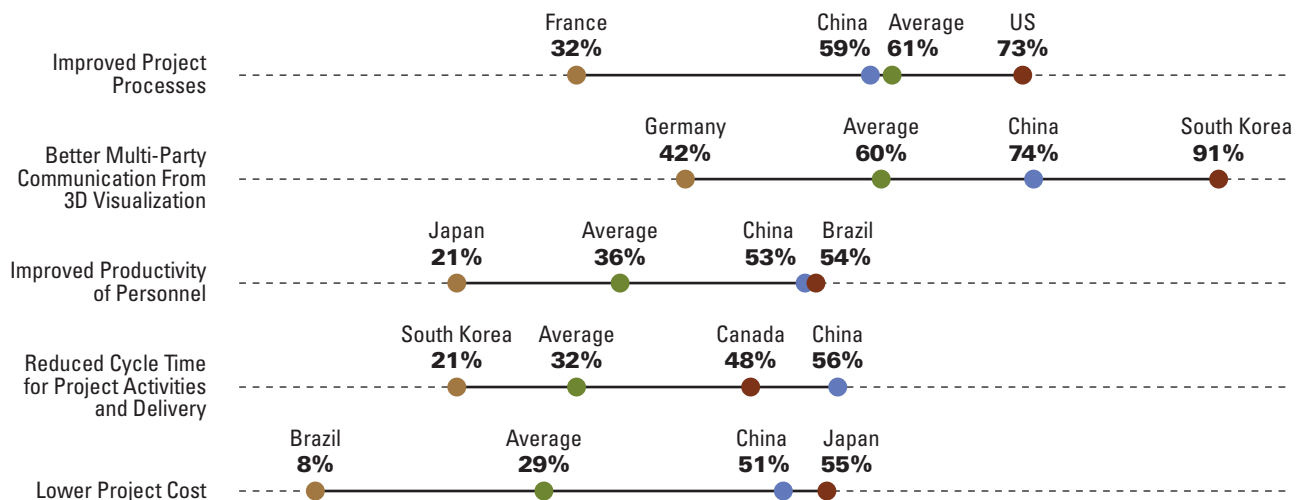
- **Chinese contractors' responses are near or above the global averages in all cases**, indicating a general commonality to contractors' interests worldwide.

- **France, Japan and Germany already have extremely high percentages (93% each) of contractors reporting positive ROI.** That may explain why they appear among those that have the fewest number of contractors highly rating the three leading benefits.
- **The focus of an emerging economy like Brazil is often opposite to that of an established economy such as Japan. This is highlighted in the reverse ratings for:**
  - **Improved productivity:** This is most cited by Brazilian contractors reflecting the high volume of work underway there and limited resources to perform it. Japan rates it lowest, likely because their economy is in a recession.
  - **Lower project cost:** This is highest rated by Japan, reflecting its tight economy, as compared with Brazil, where cost is least important as they currently face an enormous volume of work.

### Percentage of Contractors Rating Improvements That Would Most Impact on Increasing ROI for BIM

(China Compared With the Highest, Lowest and Average Among 10 Regions)

China Data: Dodge Data & Analytics, 2015; Other Country Data: *The Business Value of BIM for Construction in Major Global Markets SmartMarket Report*, Dodge Data & Analytics, 2013



# Portfolio Scale BIM: Amplifying Integration and Collaboration

## Shanghai Disneyland Resort

SHANGHAI, CHINA



Birds-eye view of Shanghai Disneyland Resort

Over a decade ago, while much of the design and construction industry was still relying on traditional methods to deliver projects, Walt Disney Imagineering (WDI) first used BIM in the development of roller-coaster projects at the Disney California Adventure Park in Anaheim, California. Over the years, WDI's BIM implementation has expanded to other project types, like hotels and attractions, and other regions, including Hawaii, Hong Kong and Shanghai.

### BIM on a Portfolio Scale

Shanghai Disney provided WDI with a valuable opportunity to integrate and apply BIM on a portfolio scale, with over 70% of the buildings in the project relying on BIM for design authoring, documentation and/or analysis. "Actually, BIM use is part of the RFP requirements, and

additional details were defined and included in the agreements with the awarded general contractors (GCs) and subcontractors," says Rolando Mendoza, director of project integration at Walt Disney Imagineering Shanghai.

Leveraging BIM throughout the portfolio has formed some synergy among projects going through design and construction at similar times, and has increased the confidence of new or resistant BIM adopters when they see other stakeholders benefiting from the BIM environment. Additionally, with all projects being nearly co-located, project teams can access and share the same resources and support, achieving some economies of scale.

### Program-Level Challenges

Mendoza identified three main challenges for this multi-project program:

- More than 140 disciplines are involved in the overall design and construction process of the entire resort, and initially many of them were not able to use BIM effectively as a tool for design and coordination. The input and voices of each project and enterprise stakeholder needed to be balanced and treated with appropriate weight when adopting and implementing collaborative BIM practices.
- Many of the awarded GCs are large and "vertically integrated," reducing the number of awarded trade subcontractors, but the workers in the field are still working in a silo, disconnected from managerial staff in the office who can't fully understand and optimize onsite activities.
- Most of the field laborers are unskilled migrant workers from remote provinces and villages around China, and are managed by labor agents subcontracted by the GC. The labor agents dispatch these workers without clear planning and understanding of the critical path and dependencies.

### Broad Collaboration

The key value of BIM is to enhance integration among WDI, local design institutes and contractors. This has several benefits. It not only ensures that design intent is accurately captured and that systems are coordinated in BIM before construction onsite, but it also facilitates collaboration and knowledge transfer among an ecosystem of BIM-enabled projects.

BIM management tools are enabling web-based social collaboration, virtual meetings and cloud-based computing to bring

## Shanghai Disneyland Resort

SHANGHAI, CHINA

together dozens of team members on opposite sides of the globe. This approach allows them to achieve key project milestones and cultivate BIM knowledge sharing. Best practices and lessons learned were effectively captured and shared across the breadth of projects to drive process improvement on a portfolio scale.

### Owner-Driven BIM

Mendoza's project integration team staff not only provided BIM training to local teams, they also managed consolidated design models for 3D coordination. In addition, they prepared 4D construction sequence simulations to share with the GCs for their use in understanding WDI's construction planning assumptions. Seeing the value of the owner-provided 4D simulations, some GCs adopted 4D for their own regular progress reporting and visualization of planned versus actual progress.

The owner-led BIM effort, along with reinforcing language in project contract agreements, was critical to achieve GC buy-in on the portfolio scale, which in turn drove BIM use by subcontractors.

### Immersive Visualization

The WDI creative team required a model integration and coordination platform with more advanced visualization beyond basic materials, color and shading. The project integration team supported by WDI's Computer Technology Group in Glendale, California, were able to use BIM to better visualize textures, materials and even special effects developed by the WDI show team. The large video wall set up onsite also allowed all project team members to get "inside" the BIM

through immersive stereoscopic visualization. The use of the video wall supported the efforts to achieve economies of scale at the portfolio scale by allowing contractors from many different projects to share and leverage for coordination and constructability reviews.

### Shorten Programming Process

An exemplary and innovative use of BIM is the early integration of the WDI show team's input in one of the attraction projects that includes animatronics and audiovisual special effects. Typically the show team requires eight months to develop show programming and calibrate equipment after the completion of construction during the "dust-free stage," which would not exist for the Shanghai portfolio. The show team shared and used the same BIM being used by the GC for construction efforts to coordinate and plan in advance the timing of show effects and placement of equipment within the model. This approach shortened the show programming process from eight months to one month and greatly reduced the time required to perform installation onsite.

### Clash Detection and Rework Reduction

For one park area, over a six-month period before the issuance of the tendering package to prospective GCs, the project team identified 3,000 clashes that were either resolved at "Big Room" meetings (integrated BIM-enabled meetings with broad team attendance) and/or as part of 160 Requests for Information (RFIs). Including the 200 RFIs generated by the GCs during the tendering stage,

there were only a total of 360 RFIs, which is substantially less than the typical number of RFIs at this stage, usually around 3,000, according to WDI sources.

The improved collaboration and integration with BIM also greatly reduced the risk of delay in the tendering stage, which is only allotted 90 days for the Shanghai portfolio of projects.

### BIM for Operations

WDI intends to use BIM to support facilities operation and management. They will by first document as-built conditions with laser-scanning technology and then internally perform the necessary updates and modifications to the GC's submitted as-built models to provide an accurate model of constructed facilities. However, the exact use cases of BIM to support operations, and the required attributes and parameters, have not yet been defined for the Shanghai portfolio. ■

#### Project Facts and Figures

##### Owner and Design

The Shanghai Shendi Group and The Walt Disney Company (Public/Private Venture)

##### Type of Project

Rides and attractions, retail, restaurants, hotels, administration and support

##### Cost

Over US\$ 4.1 billion

##### Estimated Completion

2015

# Data: BIM Investments

## Investments in BIM

BIM programs require ongoing investments in hardware, software, training and processes in order to realize their potential value. Dodge Data & Analytics (DD&A) has been tracking the categories of BIM users' investments—both in terms of current spending and plans for future investing—in its BIM research since 2009.

The investments rated in this research are divided into two categories:

- **Processes and People:** Investments like collaborative processes and staff training
- **Technology and Content:** Investments like hardware, software and BIM content

Chinese architects and contractors were asked to identify a forecasted level of investment over the next two years, from no investment to high/very high investment (1 million RMB or more per year—roughly equivalent to US\$160,000). The two charts represent those planning high/very high investments in BIM.

### BIM Investments in Processes and People

#### DEVELOPING COLLABORATIVE BIM PROCESSES WITH EXTERNAL PARTIES

This is highly rated by both architects and contractors (17% each), which is an important finding because it indicates an interest in leveraging BIM to improve the working relationship between those types of companies.

This also aligns well with other research findings, such as the top benefit identified by US and UK owners in *The Business Value of BIM for Owners SmartMarket Report* (2014), which is better team coordination/collaboration.

#### INCENTIVES OF THE STAFF TO USE BIM BY PROMOTION; DEVELOPING INTERNAL BIM PROCEDURES; BIM TRAINING

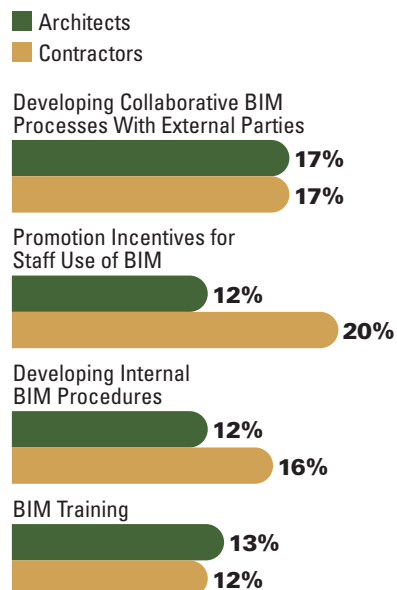
These are all internally focused investments that expand a company's BIM skills and encourage more BIM implementation.

- **Contractors are most committed to providing incentives to their staff to use BIM by promotion, reinforcing the growing career value of BIM skills for staff in those organizations.**
- **As shown on page 28, a company's BIM ROI increases in direct proportion to its level of BIM implementation, so these types of investments should create tangible beneficial impacts.**

### BIM Investments in Processes and People in China

(Percentage Planning to Invest More Than 1 Million RMB Over Next Two Years)

Dodge Data & Analytics, 2015



- **Internal training and collaboration processes are important, but less so than the focus on external collaboration.** This speaks to the rapid maturing of BIM in China and growing acknowledgement that the true power of BIM is in using models to improve workflow between project team members.



### BIM Investments in Technology and Content

#### SOFTWARE CUSTOMIZATION OR INTEROPERABILITY SOLUTIONS; NEW/UPGRADED COMPUTER HARDWARE; BIM SOFTWARE

These hardware/software investments will expand and strengthen the technical infrastructure of organizations so that they can rapidly increase the scale of their BIM initiatives.

- **The plan to invest in software customization and interoperability is top among all investment types studied in this China research and is shared with equal intensity by both architects and contractors.** This was also identified as a top investment category by all users in *The Business Value of BIM in North America SmartMarket Report* (2013).
- **More architects (26%) are planning serious investment in hardware and software than contractors (19%).** This may be because of their primary role in authoring and analyzing models, which can require several types of software and enhanced computing power.

#### DEVELOPING CUSTOM 3D CONTENT LIBRARIES

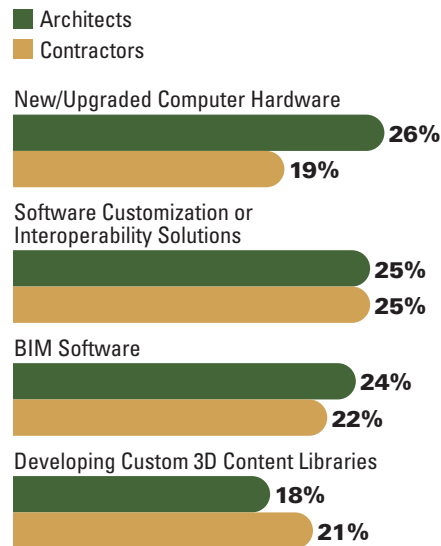
This is a common investment need identified in many of the DD&A BIM research studies around the world. For example, it ranked third among all users in both *The Business Value of BIM in Korea SmartMarket Report* (2012), and *The Business Value of BIM in Australia and New Zealand SmartMarket Report* (2014).

Chinese architects and contractors need to work with product manufacturers to urge them to create useful libraries of BIM content that can be easily accessed and used, so companies can reduce their need to develop content internally.

### BIM Investments in Technology and Content in China

(Percentage Planning to Invest More Than 1 Million RMB Over Next Two Years)

Dodge Data & Analytics, 2015



# Expanding the Possibilities of Design With BIM

## Phoenix Media Centre

BEIJING, CHINA

In 2008, the government-owned Beijing Institute of Architectural Design (BIAD) was commissioned with the design of the headquarters of China's largest private broadcaster, Phoenix Television, breaking a trend of foreign architects landing many iconic buildings in Beijing over the past decade.

The building design is unique: a ballooning torus form, which contains 65,000 square meters of media production and office spaces, including a dedicated visitors' pathway that winds through the building's broadcasting studios. "In the past, only overseas architects

were able to develop and execute this type of organic architecture, but our office was able to skillfully leverage BIM to execute the ambitious design with exceptional quality," says Mr. Weiping Shao, executive chief architect of BIAD.

### Turning Risks to Opportunities

Shao admits that using such a non-linear form for the design concept was a bold decision, as it would demand advanced techniques to develop and document the design beyond the schematic phase. This left the team with little choice but to use BIM to support the ongoing

design process. In the early stage of implementation, the design team expected BIM only to resolve certain technical challenges, assist with detailing work and help ensure the design development was progressing as planned. However, over time the team realized the value of BIM was much larger, and that the design intent and other issues would likely not have been efficiently resolved and executed without the use of BIM. By evaluating the project challenges and deciding to adopt BIM early, the team mitigated many potential risks, saved time and increased quality over the use of more traditional methods on a complex project.



The striking torus shape of the Phoenix Media Center was made possible by the use of BIM by the design team.

CONTINUED

## Phoenix Media Centre

BEIJING, CHINA

### Growing Pains of Using BIM

While BIM offered many benefits, adopting it initially involved learning more about it. Mr. Shao states, “We continuously faced different challenges from the start of involving BIM in the process. Before BIM was able to help us solve design issues, we needed to first understand the strengths and weaknesses of the tool.”

The design team started using advanced parametric BIM capabilities immediately, defining complex geometries and structural frames. BIM posed another challenge later in the design phase as the team commenced drawings documentation. Many of the staff involved were new to BIM and accustomed to the long established drafting conventions and deliverables. Shao’s team had to concurrently research and define many unconventional workflows to provide data interoperability and ensure a seamless transition of information between design and construction.

### Facility Management

Because the team developed a comprehensive model with design and construction information embedded, the model can be relied upon to support analyses of facility operation performance. “We have prepared the model to simulate security and safety control, make energy consumption calculations and organize activities. Using BIM to support facility operations has a very bright future” says Mr. Shao.

#### Project Facts and Figures

##### Owner

Phoenix Television

##### Architect

BIAD UFO (Beijing Institute of Architectural Design Unforbidden Office)

##### Type of Project

Media production facilities, broadcasting studios, office spaces

##### Size

65,000 square meters

##### Completed

2012

### BIM Standardization

Due to their work on an early BIM project in China, the project participants are uniquely positioned to understand key strategies needed in China for more effective BIM use.

As BIM adoption grows, there will be an increased demand for detailed requirements and standards, including enterprise and project-specific BIM guidelines, as well as industrywide standards. Mr. Shao is very optimistic about BIM adoption and its improvements to efficiency and quality, but he does see the current gap between the quality and productivity achieved in the manufacturing sector, as compared with the design and construction industry.

With more universal BIM standardized processes and conventions, this gap can be narrowed, and technology will be more accessible and integrated, bringing more benefits throughout the industry. Mr. Shao points out, “A BIM manual is something we should

organize throughout our practice, but for now we are only focused on BIM in some projects, though we have set up some BIM regulations, guidelines and technical requirements.”

### BIM Transformation

The use of BIM on this project demonstrates the potential that BIM holds for improving the design process for complex projects. Traditional design methods typically do not allow for non-linear and complex design possibilities to be efficiently defined and explored. BIM makes the evaluation of these alternatives feasible. It opens up great potential in design creativity, while also supporting the ability for a complex project to achieve increases in accuracy, quality and collaboration.

The increase in precision and reduction in errors and waste enabled by BIM are in themselves significant benefits, even in more traditional projects. However, these benefits also lend themselves to increased value and a higher-quality facility for occupants. Based on his experience on this and other BIM projects, Mr. Shao explains BIM’s transformative benefit: “In the long run, BIM will expand our design boundaries, and maybe push the boundaries of project management and facilities operation, presenting new opportunities and benefits to many project stakeholders.” ■



## Trade Contractor Proficiency in BIM

### Importance of BIM Expertise in Selection of Trade Contractors

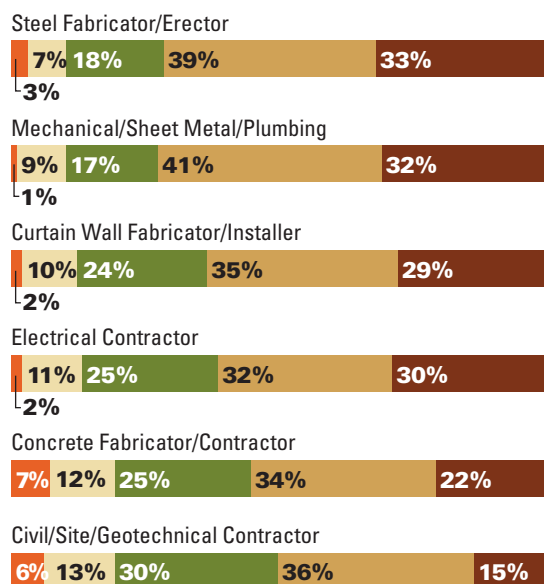
Chinese contractors were asked how important a subcontractor's level of BIM expertise is in selecting that company for a project. The chart below shows the results from Chinese contractors in combination with findings from contractors in a variety of global markets, originally published in *The Business Value of BIM for Construction in Major Global Markets SmartMarket Report* (2014).

- Chinese contractors are in step with other contractors from major construction markets around the world, with a third (33%) saying they require BIM skill from subcontractors and over half (55%) encouraging it.
- The highest proportion of contractors who require BIM from their subcontractors is found in Germany (39%) and France (37%), areas where BIM has been an established process for many years.
- As participants in a fast-growing economy, a large number of Brazilian contractors (37%) have also mandated BIM from their subcontractors, and very few (13%) are completely unaffected by BIM proficiency.
- The number of UK contractors requiring subcontractor proficiency is bound to increase dramatically as the central government BIM mandate goes into effect in 2016.

### Contractors' Importance Rating of BIM Skills for Specific Trades in China

Dodge Data & Analytics, 2015

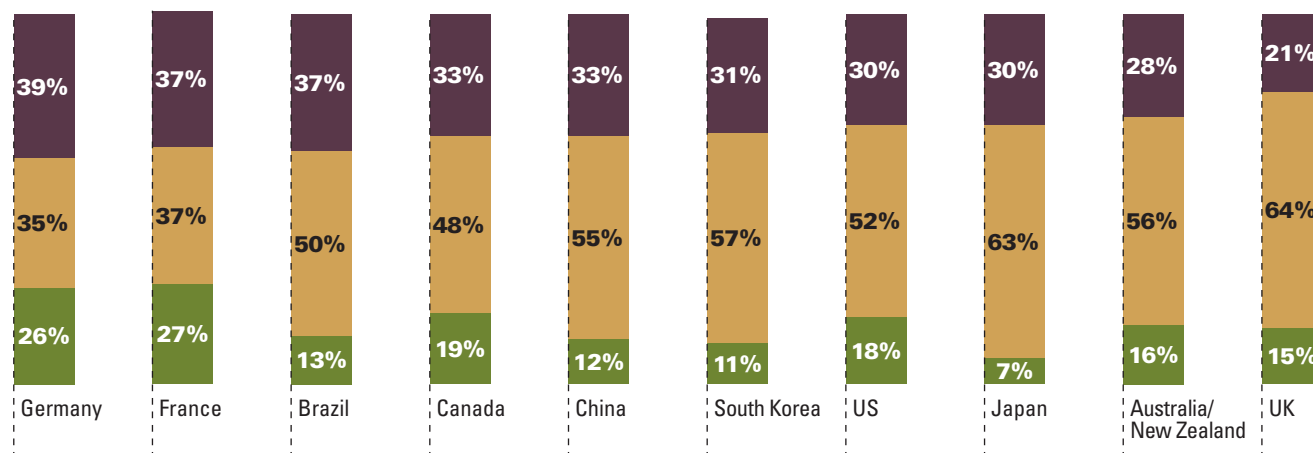
None Low Medium High Very High



### Importance of BIM Expertise in Selection of Trade Contractors

China Data: Dodge Data & Analytics, 2015; Other Country Data: *The Business Value of BIM for Construction in Major Global Markets SmartMarket Report*, Dodge Data & Analytics, 2013

- We require companies be experienced in BIM.
- We encourage BIM expertise but do not require it.
- BIM expertise does not affect our decisions.



## Trade Contractors

### Trade Contractor Proficiency in BIM

CONTINUED

#### Contractors' Importance Rating of BIM Skills for Specific Trades in China

The chart on the right on page 40 represents contractor ratings of the relative importance of trade contractor BIM skills by trade.

- **Steel and mechanical contractors are both top rated.** This makes sense because of the extensive modeling that is increasingly being done by these trades, especially to facilitate prefabrication.
- **Curtain wall and electrical are the next most valued and only receive 2% rating for no importance.**
- **Concrete and civil contractors have less advanced BIM skills, so it is natural that they are not perceived at the same importance level as the others.** However, only 7% of contractors rate them as having no importance at all.

#### Contractors' Satisfaction With the BIM Skills of Specific Trade Contractors

The chart at right shows the comparison of general contractors' ratings of the importance of the BIM skills of trade contractors with their assessment of the actual BIM skill level of those trades through:

- The percentage of Chinese contractors who say BIM skills from that trade is of high/very high importance
- The percentage of Chinese contractors that rate BIM skills from that trade as satisfactory
- The average percentage of general contractors from 10 global regions who rated BIM skills from that trade in their region as high/very high, as originally published in *The Business Value of BIM for Construction in Major Global Markets SmartMarket Report* (2014)

Trends that appear in the findings include:

- **BIM skills of steel and mechanical trades are the most important, both in China and across the globe.**
- **Mechanical shows the closest alignment between importance and competency among all trades.**
- **Curtain wall and concrete show the greatest disparity between importance and competency in both China and the global regions.**

#### The Benefit to General Contractors of Trade Contractor BIM Proficiency

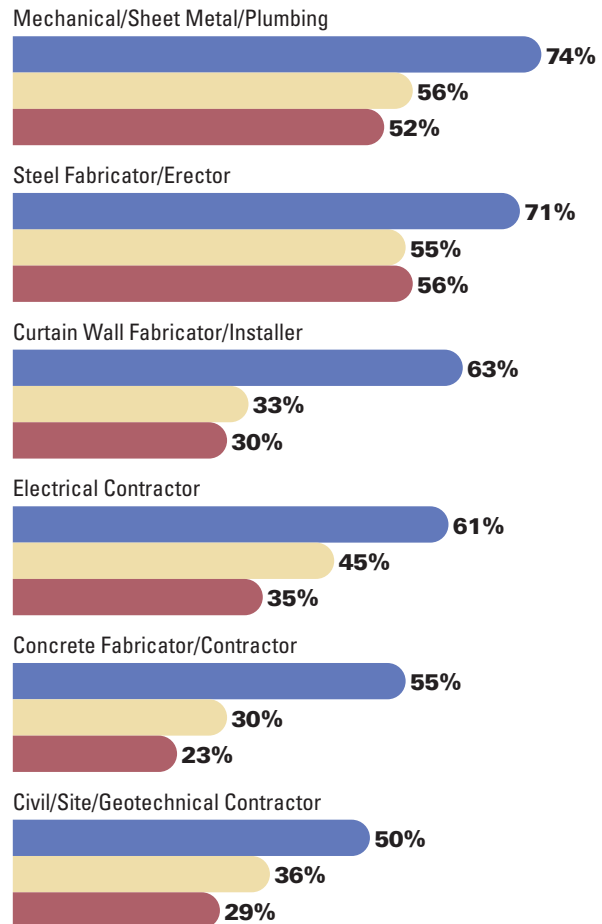
To determine how valuable subcontractor BIM expertise is to Chinese general contractors, they were asked to rate the degree to which they experience a number of specific benefits as a direct result of trade contractors' BIM expertise. The percentages below represent contractors

#### Contractors' Satisfaction With BIM Skills of Specific Trade Contractors

(China and Average of 10 Global Regions)

Dodge Data & Analytics, 2015

- Contractors in China That Rate Trades' BIM Expertise to be of High/Very High Importance
- Contractors in China That Rate Trades' BIM Expertise to be Satisfactory
- Contractors in 10 Global Regions That Rate Trades' BIM Expertise to be High/Very High in Their Markets



who gave either a high or very high rating to the positive impact of trade contractors' BIM proficiency.

- **Increases Project Quality: 64%**
- **Increases Innovation: 55%**
- **Reduces Overall Project Duration: 53%**
- **Reduces Cost: 52%**
- **Increases General Contractors' Profit: 51%**



## Regional Variations in BIM Use, Benefits and Value Drivers

**Interesting regional differences across China about BIM emerge as adoption and implementation continue to grow and users experience varying levels of benefits.**

### Forecasted Growth of BIM Implementation by Region

The chart below shows the current percentage of users who are at high or very high implementation levels (meaning that more than 30% of their projects involve BIM), and the percentage who predict that they will be at that intensity two years from now.

- **Shanghai (32%) currently leads implementation among the regions, but North China (28%) and South China (26%) are close behind.**
- **The Beijing and Central China regions predict dramatic growth. Each is currently at less than a quarter (20% and 23%, respectively), and both will nearly triple (to 58% and 65%, respectively) over the next two years. This indicates a great opportunity for the companies in these regions to benefit from a powerful surge of BIM use.**

### Variation in Benefits and Value Drivers

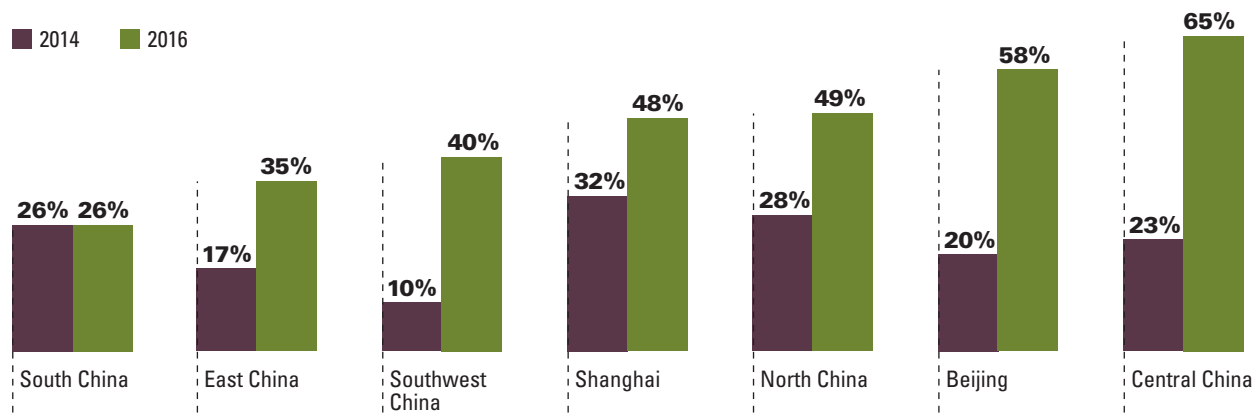
BIM users in China express a wide variety of perspectives on the level of benefits they are currently receiving, what factors will increase their BIM benefits and what benefits will improve their ROI on BIM.

The matrix on page 43 summarizes the differences between BIM users in the seven regions from which there was a sufficient response to the survey to support a regional analysis. The matrix also provides the overall averages as a comparison. Benefits are divided between business benefits (those that directly impact the user's organization) and project benefits (those that improve project outcomes).

- **The urban centers of Beijing and Shanghai feature the greatest percentages of users who are receiving both business and project benefits at a high or very high level.** This would suggest that the best practices of these users should be disseminated to other regions so that the entire Chinese economy can rapidly expand their enjoyment of BIM benefits.
- **North China is the highest-scoring region nationally in several key benefits, and is worthy of study to see if practices there can be scaled to other regions, including reduced errors and omissions (83%), reduced number and need for contractor information requests to architect (74%), reduced rework (69%) and maintaining repeat business with past clients (54%).**

### BIM Implementation by Region (According to Architects and Contractors Who Report More Than 30% of Their Projects Use/Will Use BIM)

Dodge Data & Analytics, 2015



**Benefits and Drivers of BIM by Region**

(According to Architects and Contractors Selecting High/Very High for Each Category Indicated)

Dodge Data &amp; Analytics, 2015

- 80%–100% Selected High/Very High
- 60%–79% Selected High/Very High
- 40%–59% Selected High/Very High
- 39% or Fewer Selected High/Very High

	Beijing	Shanghai	Southwest China	South China	East China	Central China	North China	Average (All Respondents)
<b>BIM Benefits With High/Very High Contribution to Future ROI</b>								
Better Multi-Party Communication and Understanding From 3D Visuals	80%	72%	67%	62%	62%	71%	63%	67%
Improved Project Process Outcomes (e.g., Fewer RFIs and Field Coordination Problems)	78%	80%	50%	54%	46%	52%	63%	58%
Improved Productivity of Personnel	43%	40%	40%	47%	42%	55%	51%	47%
Positive Impact on Sustainability	50%	40%	40%	54%	42%	42%	46%	47%
Reduced Cycle Time for Project Activities and Delivery	45%	28%	33%	54%	35%	48%	47%	45%
<b>Factors With High/Very High Importance for Increasing BIM Benefits</b>								
Improved Interoperability Between Software Applications	83%	88%	70%	69%	65%	68%	66%	72%
More Clearly Defined BIM Deliverables Between Parties	85%	76%	67%	59%	65%	65%	71%	69%
Improved Functionality of BIM Software	83%	84%	70%	67%	58%	61%	71%	69%
More Hard Data Demonstrating Business Value of BIM	78%	80%	63%	56%	63%	68%	63%	67%
More Owners Asking for BIM	88%	80%	70%	64%	57%	55%	71%	67%
More 3D Building Product Manufacturer-Specific Content	78%	72%	60%	59%	65%	58%	63%	67%
More Internal Staff With BIM Skills	85%	80%	63%	67%	63%	74%	74%	66%
More External Firms With BIM Skills	73%	88%	60%	59%	57%	55%	60%	64%
<b>Internal Business Benefit Experienced at High/Very High Level</b>								
Enhancement of Organization's Image as an Industry Leader	90%	88%	67%	67%	51%	71%	54%	66%
Faster Client Approval Cycles	68%	84%	57%	62%	54%	58%	71%	54%
Marketing New Business to New Clients	58%	68%	40%	46%	43%	51%	56%	50%
Offering New Services	58%	68%	47%	54%	39%	36%	49%	49%
Maintaining Repeat Business With Past Clients	48%	48%	47%	51%	37%	52%	54%	48%
<b>Project Benefit Experienced at High/Very High Level</b>								
Better Design Solutions	85%	80%	63%	80%	55%	58%	71%	69%
Reduced Errors and Omissions in Construction Documents	83%	76%	63%	69%	55%	61%	83%	69%
More Client Involvement and Improved Understanding	78%	84%	43%	62%	60%	52%	60%	63%
Reduced Number of Field Coordination Problems	68%	80%	50%	54%	42%	45%	72%	57%
Reduced Rework	48%	52%	60%	62%	48%	42%	69%	54%
Better Collaboration With Other Project Team Organizations	65%	60%	46%	53%	52%	55%	51%	54%
Reduced Number and Need for Contractor Information Requests to Architect	58%	56%	47%	64%	34%	36%	74%	51%

**Regions Identified in the Charts:**

- **Southwest China:** Includes Sichuan, Yunnan, Guizhou, Tibet and Chongqing

- **South China:** Includes Guangdong, Guangxi, Hainan, Guangzhou and Shenzhen
- **East China:** Includes Shandong, Jiangsu, Anhui, Zhejiang, Fujian and Jiangxi; excludes Shanghai

- **Central China:** Includes Hubei, Hunan and Henan provinces
- **North China:** Includes Tianjin, Hebei, Shanxi and Inner Mongolia; excludes Beijing

## Use of BIM for Infrastructure Projects in China

**While the private sector may have led the push for BIM adoption in the vertical building construction space, the Chinese government has now set out to establish national standards for BIM utilization in different infrastructure areas.**

**O**ne infrastructure segment in China that has embraced BIM is the hydropower business.

Experts say about 10% of the new and upcoming hydroelectricity projects have a significant BIM element. Two other sectors, the railways and municipal and city planning areas, are using BIM in 2% to 3% of new projects. The least use is in the road and highways sector, where less than 1% of new projects use BIM.

### Hydropower

"Hydropower designing is complex business. It requires innovative approaches and is best done using 3D. This is why there is need as well as demand for BIM," explains Harry Luo, who deals with clients in the infrastructure side of Autodesk's business in China.

The task of adaptation and designing major hydropower projects is led by the Kunming Hydropower Design Institute, which is owned by the China Power Construction Group, but is regarded as a national institute. "The Kunming Institute has found creative ways to use BIM. The industry is keenly watching what they are doing," says Yi Sun, an Autodesk expert.

Use of BIM in hydrological projects is very important for the government, as it wants hydropower to partially replace coal-fired electricity generation. China is committed to reduce carbon emission by 15% in

the next decade and would like to use this software in a wide range of carbon-cutting applications.

### Railways

The China Railway Corporation (CRC) has set out to create national standards for using the software in some challenging areas like tunnel design, bridge planning and line alignments.

"There is a push in favor of BIM since the reorganization of the railway administration," a government official says. The railway administration has realized that 2D is not sufficient for tunnel and line alignment work, and 3D solutions are required. BIM's capability for clash detection and curbing waste are particularly prized by the railways because of the ability to tackle problems like overshooting project costs and avoiding costly rework.

"The government is pushing the railway authorities to expand the network, complete the process of track modernization and quickly switch over to a high-speed system. Design institutes won't be able to cope with the pressure if they persist in traditional ways. This is what is producing demand for BIM," one of the software's vendors says.

### Other Sectors

There is also growing use of BIM in city planning and urban infrastructure development projects like water works and waste water disposal systems. The Shanghai Municipal Design Institute is leading

the process of adapting BIM codes to local requirements, industry sources said.

However, awareness of BIM is very low in the road and highway sector. Most planners believe that the 2D method is good enough because roads do not have major challenges, except on rare occasions when a tunnel is required. Few useful templates fusing BIM and Chinese design standards are available for ready use, industry sources say.

### Challenges

For the majority of infrastructure projects in China, BIM is not yet widely used. One challenge is that most executives are highly concerned with the confidentiality of project information. Therefore, concentrating project data into centralized models presents a perceived security risk, which will need to be addressed.

Given the logistical challenges faced by Chinese construction firms, from building massive dams on the mountain ranges of Tibet to cutting through boulders to make roads, bridges and railways that connect central Asia with its western province of Xinjiang, the advantages of using cloud-driven BIM should ultimately drive its use. ■

## Non-User Attitudes Toward BIM

Survey respondents who report neither authoring models nor working with models authored by others are identified as non-users of BIM in this analysis. Their perspective provides insight into the potential for increased use of BIM in China.

**Non-BIM users in China are very open to using BIM and generally positive about its potential.** When asked to indicate which of five statements best described their attitude toward BIM, 48% of the architects and contractors not using BIM selected one of two positive statements about the use of BIM:

- We are actively evaluating BIM (39%).
- We believe BIM will be valuable for us but have not begun evaluating it (9%).

**A high percentage of non-BIM users are more neutral but are still open to exploring BIM's potential value (41%).** It is also notable that none of the non-users in China indicated that they had actually tried BIM and decided not to work with it again. Thus, the only negative response comes from those who are not interested in BIM. These findings demonstrate that there is strong potential for wider BIM adoption in China.

**The only notable difference between architects and contractors is that a higher percentage of contractors (48%) are actively evaluating BIM compared with architects (33%).** This suggests that the use of BIM is likely to increase more steeply for contractors than it is for architects in the near future and is in keeping with the global trend of rapid adoption among contractors reported in *The Business Value of BIM for Construction in Major Global Markets SmartMarket Report*.

### Parallels With Non-Users in North America

These findings are consistent with the findings in North America by the series of Dodge Data & Analytics studies that showed that a relatively high percentage of non-users were neutral about BIM in 2009, when the use of BIM was still emerging in the market. When it became more established by 2012, the percentage who were neutral dropped significantly, as more firms were exposed to BIM and had an opinion about its value for their company. Interestingly, the percentage with a positive attitude also dropped, likely due to the fact that many of those had, by then, become BIM users. It is likely that the China market will follow a similar pattern.

### Non-User Attitudes Toward BIM (According to Chinese Architects and Contractors Who Do Not Use BIM)

Dodge Data & Analytics, 2015

We are actively evaluating BIM.



We believe BIM will be valuable for us but have not begun evaluating it.



We are open to exploring BIM's potential value for us.



We have no interest in using BIM.



## Most Important Reasons for Not Implementing BIM

Chinese architects and contractors who are not using BIM were asked to rate the importance of several different potential reasons in their decision not to use it, and the chart represents the reasons rated as having a high/very high influence on their choice.

**The expense of upgrading software/hardware was the only reason considered very influential by a high percentage of both architects and contractors.** Previous Dodge Data & Analytics (DD&A) studies in North America and Australia/New Zealand have also found that non-users have concerns about the expense of initially engaging in BIM. Interestingly, architects in China show a higher degree of concern about the expense, although it still ranks as the second highest factor for contractors.

Other than the cost of implementing BIM, architects and contractors have very different perspectives on the most influential reasons for not using BIM.

### Architects

The ability to work effectively with the rest of the industry if they adopt BIM is a clear concern for Chinese architects, demonstrated by the other top two reasons that they are not using BIM currently.

#### ■ Not Enough Demand From Clients/Other Firms:

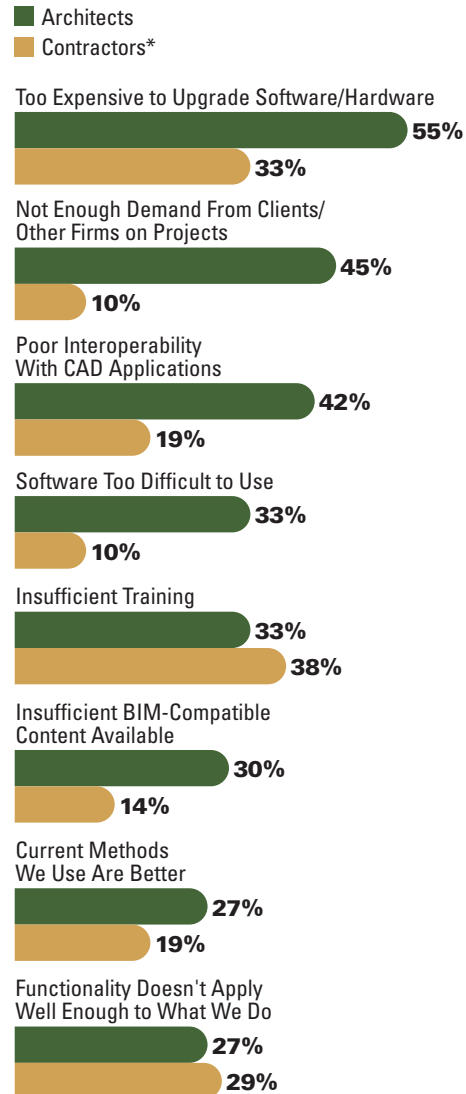
The second highest percentage of Chinese architects (45%) consider this factor influential, a finding consistent with architects and contractors from North America and Australia/New Zealand in previous BIM research conducted by DD&A. This finding demonstrates the importance of industry and owner leadership in driving greater BIM use. The surprising finding, in fact, is how few contractors note that this is an influential factor preventing them from adopting BIM.

#### ■ Poor Interoperability With CAD Applications:

Within an architect's firm, better interoperability between CAD and BIM would aid in the initial onboarding of the software. However, since BIM is still emerging as a widely used technology in China, this finding may also reflect concern among architects that use of BIM may create problems with dealing with project team members who have not yet adopted BIM.

### Most Important Reasons for Not Adopting BIM (According to Respondents Who Do Not Use BIM)

Dodge Data & Analytics, 2015



\*Small Sample Size—Represented for Trend Analysis Only



## Non-Users

### Most Important Reasons for Not Implementing BIM

CONTINUED

#### Contractors

The top concern for contractors, selected by a higher percentage even than those concerned about the cost of implementing BIM, is insufficient training. This finding should serve as a strong message to the industry that more training is a critical factor in increasing BIM adoption in China.

The only other reason considered highly influential by more than 20% of contractors is the perception that BIM functionality doesn't apply well enough to what they do. This finding suggests that training on BIM skills is not sufficient; the industry must also increase overall awareness of the effectiveness of the use of BIM on a range of project types and sizes.

Perhaps the most striking finding, though, is how few contractors consider any of these reasons to be particularly important, with no more than 40% of contractors rating any of these reasons as highly influential. This finding is unique; in the DD&A research among non-users in North America and Australia/New Zealand, while the priorities of architects and contractors may vary, roughly the same percentage overall found many of the reasons for not adopting BIM to be influential. This finding, combined with their overall positive attitude toward BIM (see page 45) may suggest that little is actively standing in the way of increased contractor use of BIM in China, should it become more widely known and its full benefits better understood.

## Perception of Competitors' and Clients' Use of BIM

Chinese architects and contractors who are not currently using BIM were asked the degree to which they believe their competitors and clients are using BIM. Both groups share the perception that BIM is not being very widely used.

- A high percentage are unsure about BIM use in their industry, especially among their competitors (41%).
- Only 29% believe that their competitors are using BIM, and even fewer (19%) think that their clients are.

These findings suggest that currently, some Chinese architects and contractors are not feeling competitive pressure to adopt BIM.

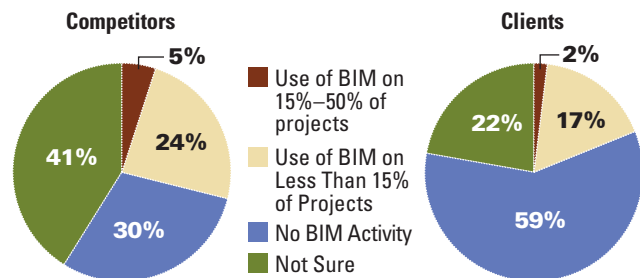
The finding is also markedly different from what non-users report in North America and Australia/New Zealand, where over 70% believe that competitors and clients are using BIM.

Overall, these findings suggest that strategies to encourage wider adoption of BIM in the Chinese market need to focus on the ability to provide new benefits to clients, rather than on the need to ensure that they are maintaining their competitiveness in their market.

#### Perception of Competitor and Client Use of BIM

(According to Chinese Architects and Contractors Who are Not Using BIM)

Dodge Data & Analytics, 2015



## BIM Benefits and Factors That Would Convince Non-Users to Consider Adopting BIM

The decision to adopt BIM often hinges on external factors and the perception of specific benefits that BIM will provide. The chart represents benefits and factors considered highly/very highly influential on their decision to adopt BIM by architects and contractors in China.

**The findings demonstrate that architects and contractors who currently do not use BIM would be influenced to adopt BIM by very different factors.**

### Top Influential Benefits for Architects

Chinese architects are most influenced by BIM's ability to help them communicate with and convey their ideas more effectively to other members of the project team.

- **Improved Communication Between All Parties in Design and Construction: Over half of architects (52%) find this factor influential.** This emphasis on improved communication echoes the results of other BIM studies conducted by Dodge Data & Analytics, such as collaboration being selected as a critical benefit of BIM by global contractors in *The Business Value of BIM for Construction in Major Global Markets SmartMarket Report* (2014).

- **Better Understanding by Client of Proposed Design: Considered influential by nearly half (46%).** In the *Business Value of BIM for Owners SmartMarket Report* (2014), the highest percentage of owners in the US and UK agree that the ability of BIM visualization to allow them to better understand a project's proposed design is a critical benefit.

**The other top benefit that architects consider to be highly influential is improved construction schedule, which is the only top three benefit for architects also selected by a relatively high percentage of contractors.** This suggests that BIM adoption would benefit from more case studies and other data that demonstrate BIM's positive impact on project schedule and can justify the resources and effort required to implement it.

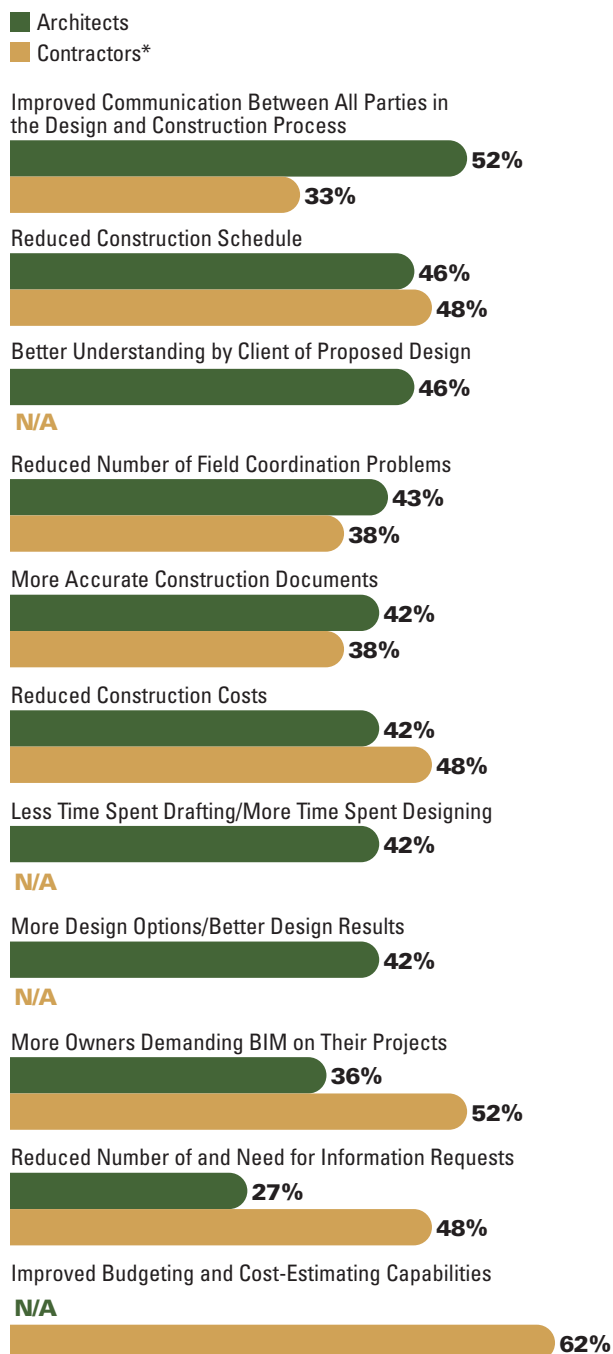
### Top Influential Benefits for Contractors

While architects place more emphasis on communication and collaboration, contractors are more influenced by owner demand and BIM benefits that improve their costs and processes, thus yielding greater productivity.

- **Improved Budgeting and Cost Estimating Capabilities: While reducing construction costs is selected as influential by nearly half of Chinese contractors (48%),**

### Benefits and Factors That Would Be Influential on Decision to Adopt BIM (By Percentage Who Find Them Highly/Very Highly Influential)

Dodge Data & Analytics, 2015



\*Small Sample Size—Represented for Trend Analysis Only

## Non-Users

### BIM Benefits and Factors That Would Convince Non-Users to Consider Adopting BIM

CONTINUED

an even higher percentage (62%) selected improved budgeting and cost estimating capabilities. Being able to depend on a reliable margin is even more important to contractors than cutting costs.

- **Reduced Number of and Need for Information Requests:** This is influential for nearly half of contractors (48%). Waiting for answers decreases the efficiency of project sites and can influence other factors like schedule.
- **More Owners Demanding BIM on Their Projects:** A higher percentage of contractors (52%) say owner demand could be influential in their future adoption of BIM than architects (36%). However, a higher percentage of architects agree that lack of owner demand is a factor in why they are not using BIM currently (see page 46). This may suggest that architects see owner demand as a requirement, but contractors view it as more of a business opportunity.

### Comparison of the Influence of Benefits and Factors in China, Compared With Other Countries

Some interesting trends emerge when comparing responses in China with other countries.

- **In general, architects and contractors in China are less enthusiastic than those in other countries about the degree to which benefits and factors would influence them to adopt BIM.** In Australia/New Zealand and in the US, eight of the benefits/factors included in the survey were selected by over 50% of architects and contractors. This is in sharp contrast to the Chinese responses, where most are selected by less than 50%.
- **Contractors and architects in Australia/New Zealand and the US both place nearly equal weight on the importance of improved communication between all parties in the design and construction process, while the percentage of contractors who consider this highly influential in China is much lower than the percentage of architects.** It is possible that strict rules about the roles of architects and contractors in China influence the degree of importance that contractors place on this benefit, compared with other construction markets.

## Importance of BIM in the Next Five Years

**Most Chinese architects and contractors (61%) who are not currently using BIM expect it to be at least moderately important to the construction industry in the next five years.** In fact, the majority of those (39% of the total architect and contractor non-users) expect it to be very important.

This finding, especially when considered in light of the overall positive attitudes of non-users toward BIM (see page 45), suggests the likelihood that BIM will be more widely used in the Chinese market in the next five years. Even though non-users currently see BIM use by others as relatively low (see page 47), these findings suggest that they are expecting to feel market pressure in the future to adopt BIM in order to stay competitive as its importance in the Chinese construction industry grows.

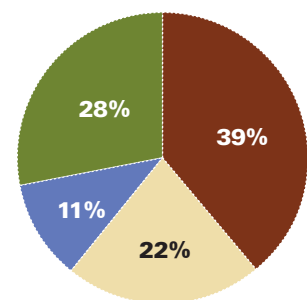
It is also worth noting that only a small percentage of non-users (11%) think BIM will not be important, underscoring the generally positive expectation.

### Importance of BIM to the Construction Industry in the Next Five Years

(According to Chinese Architects and Contractors)

Dodge Data & Analytics, 2015

- High/Very High Importance
- Moderate Importance
- No/Low Importance
- Not Sure



A much higher percentage (28%) of non-users are unsure, suggesting the need for more education on the competitive benefits of BIM among Chinese firms.

## Factors Delaying the Decision to Use BIM

Architects and contractors in China who are currently not using BIM were asked to rate the impact of a series of factors that could potentially be delaying their decision to use BIM, from not causing a delay at all to causing a high/very high degree of delay.

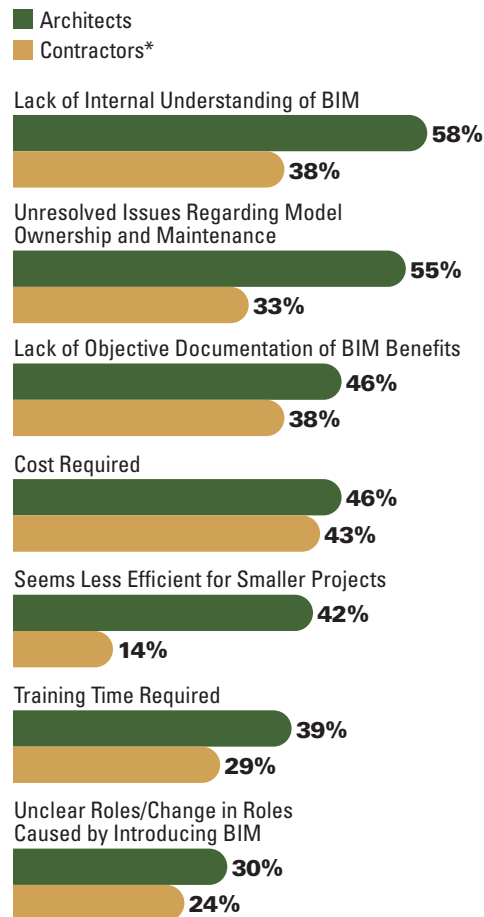
**A high percentage of Chinese architects and contractors note that delays are being caused by factors that can be addressed through interventions like more education, policy changes and better data.**

- **Lack of Internal Understanding of BIM: Selected by 58% of architects and 38% of contractors.** This finding suggests the need for wider education about BIM and that focusing on the education of people who can serve as BIM champions within organizations could be a valuable approach to increasing overall BIM adoption.
- **Unresolved Issues Regarding Model Ownership and Maintenance: Selected by over half (55%) of architects and one third (33%) of contractors.** This issue can be addressed by clearer policy regarding model ownership and maintenance in the industry, offering a critical opportunity to allow more firms to begin using BIM.
- **Lack of Objective Documentation of BIM Benefits: Selected by nearly half (46%) of architects and over one third (38%) of contractors.** Policy and education can both help address this, as is evident from the efforts surrounding the launch of the national BIM mandates in the UK and Singapore. In addition to mandating the use of BIM, both of these governments are also providing resources to demonstrate the positive impacts of BIM as part of their overall strategy to see wider BIM adoption in their construction industries.

**The largest difference in the responses of architects and contractors is on the impact of the perception that BIM is less efficient for smaller projects, with a relatively high percentage of architects (42%) noting this as an important source of delays, compared with a low percentage of contractors (14%).** Non-user design firms will need to see more examples of how BIM can be effective on smaller projects.

### Factors Causing a High/Very High Delay in the Decision to Use BIM (According to Non-BIM Users)

Dodge Data & Analytics, 2015



\* Small Sample Size—Represented for Trend Analysis Only

## Most Important Factors Encouraging BIM Adoption

Architects and contractors in China who currently do not use BIM were asked an open question about the single most important factor that would encourage them to adopt BIM. Even though the number of respondents who provided an answer is relatively low, some interesting trends emerge in factors that have the potential to motivate architects and contractors to adopt BIM.

### Architects

Increased client or market demand for BIM would have the greatest impact on encouraging architects to use BIM, with 35% offering this as the single most important factor. This corresponds to the previous finding that lack of client demand has a high impact on the decision of 45% of the architect non-users to not adopt BIM thus far (see page 46).

The other factor mentioned by a relatively high percentage of architects (27%) is the opportunity BIM offers for increasing efficiency and improving work. This suggests that unbiased data on the process improvements associated with BIM need to be made more widely available to the architectural community in China.

Budget/growth and innovation were mentioned by less than 20% of architects.

### Contractors

For contractors, the impact on their own profitability and ability to grow as a company, selected by 26%, outweigh all other factors—even client demand—as drivers for BIM adoption. Again, this demonstrates the need for unbiased data in China on the ways that BIM has helped contractors to maximize their budgets and grow their businesses.

However, the highest percentage of contractors (33%) stated that they do not know what would increase their interest in BIM adoption in the future or mentioned some unique factor not discussed by others. This finding, combined with the findings that point to interest by their company leadership as the key driving factor, suggests that a notable percentage of the contractor non-user respondents have not fully considered the potential of BIM for their companies. This could imply that the China market for BIM has the potential to grow if more information could be made available to contractors about what BIM offers.

### Most Important Factors Encouraging BIM Adoption (According to Non-BIM Users)

Dodge Data & Analytics, 2015

Architects	Contractors
1. Client/Market Demand	1. Budget/Growth
2. Efficiency/Improving Work	2. (tie) Efficiency/Improving Work
3. Budget/Growth	2. (tie) Client Demand
4. Innovation	2. (tie) Company Decision



## Government-Driven BIM in Shanghai

**Shanghai is leading the way in local government efforts in China to encourage companies to use BIM.**

### Standardization to Accelerate BIM Adoption

BIM has been in use by the local Shanghai design and construction community for over a decade. It has been primarily applied on a selective basis by larger design institutions, construction firms and steel and curtain wall subcontractors. It is also common for BIM consultants to manage the authoring and integration of project models and lead the coordination efforts of multi-disciplinary project teams.

Though local designers and builders may be familiar with the value proposition of BIM and are eager to expand their BIM use, widespread adoption remains slow to develop. Many are reluctant due to the lack of organized and systematic guidelines and protocols to standardize BIM collaboration and project delivery.

### Government Promotion of BIM Standardization

Addressing this need, the Shanghai Urban Construction and Communications Commission (SUCCC), which oversees urban planning, quality and safety monitoring of construction projects, has led an assessment of the state of BIM practice in Shanghai. The assessment covers BIM use and development in design and construction companies, BIM consultants, software vendors and research institutions. The outcome will be an SUCCC BIM guideline, which promotes the piloting of BIM uses and development of standards along a well-defined timeline.

- By the end of 2016, policy and standards will be in place to support and guide the growing market for BIM, in particular, leveraging BIM for facility management and operation.
- By the end of 2017, projects with government investment above 100M RMB or building area above 20,000 square meters will be required to implement BIM. The mandate will initially focus on government-funded projects, facilitating the diffusion and promotion of BIM in local industry.

The SUCCC recommends five major steps to expanding BIM adoption in Shanghai's local industry:

- Encourage a wide range of pilot projects to demonstrate BIM value and promote adoption of BIM applications.
- Establish standardized protocols, processes and requirements.
- Improve governmental project monitoring and approval process.
- Enhance BIM implementation capabilities through training and improved software effectiveness.
- Encourage diverse BIM application throughout the project lifecycle, such as industrywide BIM object libraries and energy analysis to support sustainable design.

The Shanghai BIM mandate will reference other successful global examples of government-driven BIM adoption, such as efforts by Singapore's Building Construction Authority (BCA); the US General Services Administration (GSA); and

the governments of Finland and Norway.

### Expanding the Lifecycle of BIM Data

SUCCC is coordinating with other Shanghai governmental departments to ensure that BIM is used at all points of the facility lifecycle, starting with design exploration in project planning, through design and construction, and leveraging the data of the final, as-built BIM for efficient facility operation. This intra-agency cooperation will help identify ways to simplify permitting approval and submission procedures with BIM, including using rule-based model checkers for evaluating code compliance and establishing the information technology infrastructure to accept, store and reliably access BIM submissions.

### Importance of the Government in Driving BIM

The standardization and regulation of BIM by the Shanghai government will increase the confidence and willingness of hesitant companies and institutions to expand their BIM implementation and help realize the transformation of the construction industry. ■

# Interview: Thought Leader

Luo Wen Bin

Deputy Director of the Institute of Building Product Applied Technology Research, China Institute of Building Standard Design & Research (CBS)

THE BUSINESS VALUE OF BIM IN CHINA

**Mr. Luo is the chief editor of *Architectural Engineering Design Information Model Classification and Coding*, and his focus is to promote BIM adoption in China through the use of standards to address fundamental industry concerns, such as information loss, liability and intellectual property.**

## **What do you think is the best way to encourage wider BIM adoption across the design and construction industry in China?**

**LUO:** Countries are using different strategies to encourage BIM adoption. For example, in Singapore, the government offers an allowance to encourage BIM use in the overall design and construction industries. In China, the government provides guidance, but it is not offering any allowance to support [BIM]. However, in some regions such as Shanghai, they require a BIM model and some documentation to keep on record for construction submittals.

I think the best method is market driven. In a market-driven approach, whether a firm is a designer, owner or contractor doesn't matter; they have to achieve the benefits of using BIM.

BIM is still in a starting phase in China. There are many applications to use for design, but I think BIM is still considered a support tool and not commonly used.

## **What challenges does the China market present to wider BIM adoption?**

**LUO:** There are many challenges. BIM has changed many things. [For] traditional 2D drawings, we have a complete procedure and related phasing [for a project]. Also, the responsibility for work was clearly divided. When we turn to 3D modeling, it changes everything, including the roles of individuals.

Second, BIM implementation is also challenging. There are many countries using their own software to solve their problems. We are still behind on this. Therefore, the [challenge of implementing] BIM is the problem of what applications to use. Generally speaking, there are safety and security issues in China. The use of software from other countries is a challenge for the government.

Coordinating standardization is also a challenge. If we implement BIM without a standard, we will waste time and effort promoting it. BIM is all about data and process. For the whole construction process, it keeps all the data for applications and solutions. If there is no standard to support it, this will be a challenge.

## **What role do you see your organization playing in the use of BIM in the next five years?**

**LUO:** We have a few directions we will take in the next five-year plan, which may be different from other Local Design Institutes. We [are focused on BIM in four areas]: design, construction, operations management and also public resources. We are promoting these four with different departments for implementation.

For public resources, [our main focus] is a BIM standard. We will also use 3D and BIM components, and other library resources, to become an integrated and standardized service. We may announce a public resource

platform next year, [which will] allow everyone to access the standard drawings and information from suppliers.

From the design [perspective], we are still using BIM professionally for design services. We also provide BIM consulting services on some projects.

We also take construction projects as part of our service to implement, including the level of control, improving BIM, tools, material and capital flows, etc.

We are also heading in this direction for operations management. We have a hospital project that is using BIM [for] operation management.

## **How do you think BIM will change the industry over the next five years?**

**LUO:** This is a very difficult question. I think that the change needs to originate in how people understand BIM. If we do not change our perspective of BIM and only use it as a tool, it is difficult to realize a substantial transformation.

We have all seen the movie *The Matrix* where one can do many things in a virtual reality environment, and I believe we can do similar things in future buildings. We have been talking about a digital city and an intelligent city, and we will continue to put more efforts in this area. We may be able to virtually walk around a beautiful Beijing from home in the future. ■

## Perspectives of Building Owners and Developers in China on BIM Utilization

**Interviews with four building owners and developers and one owner representative reveal no clear consensus from an owner's perspective of the degree of implementation of BIM in the market. However, many do agree on the challenges faced and steps needed to encourage wider BIM use in China.**

Owner recognition of the value of BIM can be a critical driver for BIM adoption in the marketplace. In order to understand owner engagement with BIM in China better, Dodge Data & Analytics interviewed four building owner/developers and one owner representative, all of whom have BIM experience and have engaged in a high volume of work in mainland China, to explore the perspective of Chinese owners on BIM.

### State of BIM in the Chinese Market

The perspectives of the five participants in the research vary widely on the level of BIM use in the Chinese market. One developer, who spoke anonymously, but whose company has developed over 20 million square meters of building space, sees rapid growth in BIM and a bright future. "We have observed a rapid revolution of BIM within China, such as the adoption of BIM capabilities within Local Design Institutes (LDIs), just over the last two years." He affirms, "The transformation from 2D to BIM is an unstoppable trend, and it is likely to become an industry standard in the next two to three years."

The remainder of the respondents are more tempered about the current adoption level of BIM in China. Mr. Ma Shen Dong, BIM leader of the Cultural Tourism Planning & Research Institute, is concerned about the

limited degree of implementation of BIM in China, while Mr. Zhong Wenwu, BIM director for YMCI, believes that BIM "will eventually become an essential element in the future for the construction industry." However, Mr. Zhong also points out that "there are quite big discrepancies among individuals and organizations in terms of understanding the values and uses of BIM."

Most of the owners affirm that their own organizations are still in the early stages of BIM use, and none of them are currently using it for building operations and maintenance. Mr. Ma makes a telling point in this regard: "We just started the learning journey of BIM, so have not planned for our college education when we are still in kindergarten. In other words, we have not defined the needs of BIM during operations, and so have not acted on it yet." However, two owners report that they are actively exploring this issue.

### Challenges to Wider Use

Some owners note that sufficient knowledge about and skill with BIM is a challenge impeding wider BIM use in China. Mr. Zhong states, "Human capital with the right mix of experience and skills is the challenge [BIM faces in further expansion]."

The lack of a better understanding of the value BIM brings to projects and firms is also seen to create challenges for its wider adoption. For example, Mr. Ma states, "Resistance from conservative design firms,

LDIs, contractors and real estate management agencies who do not see BIM as a value-adding tool and process to their current practice is another major challenge we are facing."

Mr. Sheng Cheng, vice general manager at Shanghai Jianke Management Co. Ltd., summarizes the general consensus that lack of knowledge is a major impediment. "Leaders and managers talk about BIM, but seldom know exactly what BIM capabilities and benefits are available. Those advocating for BIM ... are often not in leadership or decision-making positions. Therefore, human, material and financial resources cannot be adequately allocated to support BIM, making implementation of BIM in mainland China very difficult."

Mr. Zhong is optimistic but notes similar concerns: "BIM will certainly be a critical tool and process for the future construction industry. However, it will take a long time before the industry can come to consensus on the values of BIM in the context of China, and then increase the preparedness of stakeholders along the entire project lifecycle to adopt this technology and process."

In addition, one developer reports that "many project stakeholders are hesitant to share their models ... the hidden concern of ... maintaining the intellectual property of model authors is a major challenge."

## Encouraging Wider Use of BIM in China

Two owners, Mr. Ma and Mr. Zhong, find that the market has a stronger influence on driving BIM than the government. Mr. Ma states, "Most organizations use BIM simply to increase their competitiveness in the market and [their] management effectiveness internally. The government does not provide much support in BIM products and solutions development." However, he does see a role for government in the future in overcoming the resistance and lack of knowledge noted by many as a challenge to BIM adoption. "More conventional enterprises and organizations rarely disrupt the current "working" process. This is when government mandate and support is critical in pushing beyond the hump."

Mr. Zhong, on the other hand, prefers that the government avoid mandates, allowing the market to drive adoption. "The current situation is ideal, with the government only giving out recommendations, but not mandatory requirements." He believes mandates do not take into account the differing needs of companies that will impact how and why they choose to use BIM.

Mr. Y.Y. Yip, the deputy general manager at Henderson Land Development, believes the government should do more to encourage BIM adoption, noting the absence of "tactical next steps to encourage owner, LDI and contractor adoption, such as streamlining the submission and approval process via BIM."

The government can also provide needed data on BIM benefits. The

owners' agent, Mr. Cheng, states, "Many owners have asked me whether or not there is an example of the successful use of BIM and say they would consider using it if such a case were presented. It could work if the government launched a few pilot projects to demonstrate the use of BIM ... The statistical data of these test projects could push the industry toward using BIM."

A few of the owners also find that owners can play a direct role in encouraging wider BIM use. Mr. Zhong states, "We can collaborate with large enterprises and use their projects as case studies... document the lessons learned, effective workflows and use cases, and then share them with the entire industry as practical guidelines." Mr. Ma agrees that owners should share successes and lessons learned to help the industry mature faster.

## Benefits of BIM Use

Owners report a wide range of benefits from BIM use that they could share with the industry. Cost reductions are the most commonly reported benefit. For example, Mr. Zhong notes that the top benefit of BIM is the "reduction of construction costs through design optimization and construction simulation," and another developer states that BIM reduces costs "by minimizing unbudgeted changes and rework."

In addition, process improvements are an important benefit of BIM. Mr. Zhong reports that BIM results in "the enhancement of the enterprise efficiency through digitization, standardization of information and the process-oriented nature of BIM management procedures [which allow for] a more

transparent review and validation process that can inform us on future improvement opportunities." Another points out that BIM's interoperability with their Enterprise Resource Planning System, which they have just begun to implement, is expected to yield greater efficiencies, not just during procurement and construction but also during building operations.

Mr. Ma cautions about a one size fits all vision for BIM benefits. He states, "whether BIM can be successful is highly dependent on how one uses it and their needs. It is not about what BIM can offer but how BIM is being applied." ■

# Methodology:

## Building Information Modeling in China Study Research

Dodge Data & Analytics (formerly McGraw Hill Construction) conducted the 2014 Building Information Modeling in China survey to examine the use of BIM by construction and architecture firms.

The research in this report was conducted through an online survey of Chinese construction and architecture firms between September 10th and October 8th, 2014. The survey was open to all such firms doing work in China, regardless of their level of BIM use.

### Definition of BIM Use in the Survey

For the purpose of the survey BIM use was defined as: BIM being used to either author models or work on models authored by another firm (or both). Those who indicated either authoring, using or doing both were noted as BIM users and those who noted they were not engaged with BIM at all were noted as non-users of BIM. Each group answered different questions about BIM and its use in China.

### Survey Participants

The survey had 350 complete responses:

- 144 respondents from construction firms
- 206 respondents from architecture firms

A quota was set for each group to ensure that at least 60% of respondents were involved with vertical building projects, as opposed to exclusively industrial construction or civil infrastructure.

The total sample size (350) used in this sample benchmarks at a 95% confidence interval with a margin of error (MOE) of 5.23%. For the

construction firms, the MOE is 8.16%. For architecture firms the MOE is 6.82%.

### CLASSIFICATION OF BIM USERS AND NON-USERS

Of the respondents, 296 were classified as BIM users and 54 as non-users of BIM.

- More BIM users were sought as their perceptions of the value of BIM in China was the primary focus of the survey.
- A smaller sample of non-users was included to get an idea of why some firms don't use BIM and what might lead such non-users to begin working with it.

For BIM users the MOE is 5.69%. The smaller sample results in a MOE of 13.3% for BIM non-users.

### Variables Used in the Analysis

The large sample size of BIM users allowed for comparisons across different subgroups, which the smaller sample size of non-users did not permit.

### SIZE OF COMPANY (BY ANNUAL REVENUE)

Roughly 9% of each respondent group selected "Don't Know," and they are not included in the analysis by size.

#### ■ Large Firms (Revenue of 800 Million or More RMB)

- 29% of architect respondents work for large firms.
- 37% of contractor respondents work for large firms.

#### ■ Medium Firms (Revenue of 60 Million to Under 800 Million RMB)

- 34% of architect respondents work for medium firms.
- 33% of contractor respondents work for medium firms.

#### ■ Small Firms (Revenue of Less than 60 Million RMB)

- 28% of architect respondents work for small firms.
- 21% of contractor respondents work for small firms.

### OWNERSHIP

#### ■ Architects

- 51% work for state-owned design organizations.
- 41% work for private design firms/partnerships.
- 8% work for other types of firms, including foreign companies.

#### ■ Contractors

- 47% work for state-owned construction enterprises.
- 49% work for private construction enterprises.
- 4% work for other types of firms, including foreign companies.

### TYPE OF WORK

#### ■ Architects

- 60% primarily work on buildings/interiors projects.
- 34% primarily work on industrial/civil construction projects.

#### ■ Contractors

- 65% primarily work on buildings/interiors projects.
- 30% primarily work on industrial/civil construction projects.

Roughly 5% to 6% report that they work primarily on building types other than the ones listed above.

### Comparisons With Other Regions

Findings from the 2014 *Business Value of BIM for Construction in Major Global Markets SmartMarket Report*, which includes data on BIM use by contractors in 10 countries, are used to provide contexts for comparisons with Chinese contractors throughout this report. ■



## Resources

Organizations and websites that can help you get smarter about the business value of BIM in China, as well as globally.

### DODGE DATA & ANALYTICS

#### Dodge Data & Analytics

Main Website: [construction.com](http://construction.com)

Dodge: [construction.com/dodge](http://construction.com/dodge)

Research & Analytics:

[construction.com/dodge/](http://construction.com/dodge/)

[dodge-market-research.asp](http://dodge-market-research.asp)

Architectural Record: [archrecord.com](http://archrecord.com)

Engineering News-Record: [enr.com](http://enr.com)

Sweets: [sweets.com](http://sweets.com)

SmartMarket Reports:

[construction.com/market\\_research](http://construction.com/market_research)

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We thank all the owners who participated in the in-depth interviews for generously sharing their insights and expertise. In addition, we thank those who participated in the case studies and were willing to share their results in order to demonstrate the benefits of BIM. We thank our two thought leaders, Professor Ming Gu from Tsinghua University and Luo Wen Bin from the China Institute of Building Standard Design & Research, for sharing their insights on BIM in China.



Autodesk  
[www.autodesk.com](http://www.autodesk.com)



Glodon  
[www.glodon.com](http://www.glodon.com)

#### Introduction to Tsinghua BIM Research Group

Founded in 2009, the BIM research group at Tsinghua University—consisting of Jianguang Sun, academician of the Chinese Academy of Engineering, Professor Ming Gu and relevant experts as well as doctoral and master students—has completed several BIM research achievements, including the “Chinese Construction Industry Information Technology Development Strategy research,” the “Chinese BIM Standard Framework Research,” the “BIM Implementation Standard Guidelines for Design Enterprises,” and the “BIM Implementation Standard Guidelines for MEP Contractors.” They also formed the Chinese BIM Standard (CBIMS) System. CBIMS directs the research and preparation of Chinese BIM standards through development of the methodology and epistemology to create a solid theoretical foundation. Tsinghua BIM research group is mainly involved in the preparation of the first BIM standard China promulgated—the Beijing local “Building Design BIM Standard”—and also involved in the promotion of the Chinese construction industry, railway industry and other local industry BIM standards preparation.

The Tsinghua BIM research group has developed a number of enterprise-level and project-level BIM implementation standards, and participates in BIM application at both of these levels. They are pioneers and leaders in the Chinese BIM standard research and practice.

#### Research Partners

bimSCORE: [www.bimscore.com](http://www.bimscore.com)

Tsinghua University: [bim.thss.tsinghua.edu.cn/](http://bim.thss.tsinghua.edu.cn/)

#### Resources in China

China BIM Union: [www.chinabimunion.org/](http://www.chinabimunion.org/) and [www.bimunion.org/html/yw/index.html](http://www.bimunion.org/html/yw/index.html)

#### International Resources:

Australia National Guidelines for Digital Modeling: [www.construction-innovation.info/images/pdfs/BIM\\_Guidelines\\_Book\\_191109\\_lores.pdf](http://www.construction-innovation.info/images/pdfs/BIM_Guidelines_Book_191109_lores.pdf)

BIMForum: [bimforum.org](http://bimforum.org)

bimSCORE: [www.bimscore.com](http://www.bimscore.com)

BIM Task Group (UK): [www.bimtaskgroup.org](http://www.bimtaskgroup.org)

buildingSMART International: [www.buildingsmart.org](http://www.buildingsmart.org)

Mortenson Construction, VDC Journey:

[www.mortenson.com/vdc-journey](http://www.mortenson.com/vdc-journey)

National Institute of Building Sciences: [www.nibs.org](http://www.nibs.org)

National Institute of Building Sciences “The COBie Guide”: [www.nibs.org/?page=bsa\\_cobieguide](http://www.nibs.org/?page=bsa_cobieguide)

RICS (Royal Institution of Chartered Surveyors): [www.rics.org/us/knowledge/bcis/about-bcis/forms-and-documents/bim-downloads/](http://www.rics.org/us/knowledge/bcis/about-bcis/forms-and-documents/bim-downloads/)

Singapore, Building and Construction Authority, BIM Guide: [www.corenet.gov.sg/integrated\\_submission/bim/BIM/Singapore%20BIM%20Guide\\_V2.pdf](http://www.corenet.gov.sg/integrated_submission/bim/BIM/Singapore%20BIM%20Guide_V2.pdf)

U.S. General Services Administration, Building Information Modeling: [www.gsa.gov/bim](http://www.gsa.gov/bim)

US National BIM Standard: [www.nationalbimstandard.org](http://www.nationalbimstandard.org)

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